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MAGNETIC TESTING.

In an article on "Some Recent Developments in Magnetic Testing," which appears elsewhere in this issue, Prof. Ewing describes a method by means of which the reluctance of the air spaces and yokes introduced in the type of permeability bridge employed by him may be determined and thus allowed for. Prof. Ewing states that the bridge method of testing is capable of giving results equal in accuracy to the absolute values obtainable by the use of the ballistic galvanometer. Owing to the expeditious manner with which the tests may be carried out on new samples of iron and steel, the method employed offers a valuable adjunct to the testing laboratories of manufacturers of electrical machinery. The standard test piece being once accurately tested by means of the ballistic method, other samples may be readily compared with it with the simplicity of measuring an unknown resistance by means of the Wheatstone bridge. The method is the same in principle as that suggested by Mr. Holden in a contribution to THE ELECTRICAL WORLD, published Dec. 15, 1894, and more fully explained in the issue of June 17 of this year. Contrary, however, to the belief expressed by Mr. Holden, that the reluctance of the air spaces was negligible, Prof. Ewing finds that, owing to the higher permeable qualities of iron and steel as now employed in the construction of electrical apparatus, it is necessary to make the more refined measurements which he suggests.

CABLE CONSTRUCTION.

In the contribution of Mr. J. Draper Bishop on the subject of cable insulation and construction, the belief is expressed that the first lead-sheathed cable was manufactured by Messrs. Siemens & Halske, in Germany. This statement may or may not pass unchallenged by some Americans who claim the distinction of being inventors of this type of construction. However, be it as it may, those who essay to dispute this opinion must be well fortified with strong evidence to the contrary in order to establish their claim. But apart from the question as to who is the original inventor, it is interesting to note what marked improvements have resulted in cable manufacture by reason of the use of lead sheathing. The important discovery, as Mr. Bishop points out, led to the renewed use of fibre and paper as insulating materials. These substances had been used to a limited extent in previous years, but the difficulty of rendering them waterproof led to their practical abandonment for cable work. The invention of the lead-sheathed cable, however, solved these difficulties, and in late years vegetable fibre and paper insulation have come into extensive use, paper being especially favored by the telephone companies. Lead-covered cables possess important advantages in the ease with which they can be manufactured and in their long life, their durability being practically unlimited, so long as the lead sheathing remains intact. For high potentials paper insulated cables have no superior, possessing, as they do, great insulation resistance and low specific inductive capacity. Another important advantage of paper insulation is that it preserves the concentricity of the conductor. When a gum insulation is used there is the possible danger of the conductor becoming eccentric and finally short-circuited by reason of the tendency to settle in the gum medium, especially where the cable is exposed to abnormal heat, within or without, or as a result of bending. It is not to be inferred, however, that confidence in India rubber, gutta-percha or other gum insulating cables has been lost, and that dry vegetable fibre and dry paper will monopolize the

field. This is far from the truth. Each class of cable has its own peculiar advantages under the specific conditions under which it is used. Mr. Bishop thinks that the cables of the future will be a combination of both types—a dry paper core with a rubber sheathing enclosed in a lead pipe. The concentricity of the conductor would be preserved in a cable of this kind, and at the same time absolute waterproof qualities would be secured. Mr. Bishop's articles are to be commended for their perspicuity and practical value.

THE RATING OF ELECTRICAL MACHINERY.

The desirability of having a uniform rating for dynamos is apparent to any one giving but the slightest consideration to the subject, but notwithstanding the repeated arguments periodically advanced in its favor, the result has been somewhat similar to the effects produced by the rantings against trusts and kindred combinations, the defects in the patent system and various other forms of existing institutions—we still await the change. No manufacturer should hesitate to stamp on the name-plate of his dynamo the voltage at which it operates, its maximum current output, its normal running speed, total capacity and the power required to drive. Given the last two factors the commercial efficiency is known and the required size of engine to meet the conditions is more readily determined. A system of numbers could be devised giving the desired information in a compact form, beginning with a letter designating the type of current, followed by the voltage, the current, speed, capacity, total output and the power required to drive. One of the older but now-non-existing companies adopted a system somewhat similar, but not so extensive. In this 4—100—600 designated a machine of 4 poles and 100 kilowatts when running at 600 revolutions per minute. The output is of little value without the corresponding voltage and current, but the number of poles adds another distinguishing feature of the machine. Stationary motors could be similarly rated, while for railway motors some such rating as that suggested by Mr. Baxter in the issue of The Electrical World of Nov. 21 might be adopted. The determination of the factors which a machine of a given output shall possess is not difficult to fix upon and should be taken up by the several interested electrical associations.

THE HOMOGENEITY OF RÖNTGEN RAYS.

We note an interesting communication on the non-homogeneous character of Röntgen rays—to which property we have alluded in these columns on several occasions—by Mr. T. C. Porter, published in a recent issue of *Nature*. Mr. Porter has succeeded in producing at will three modifications of Röntgen rays, which he designates as X_1, X_2 and X_3-rays. The X_1-rays readily penetrate flesh, but to them bone is quite opaque; X_2-rays penetrate wood, but not flesh, and to the X_3-rays bone is almost as transparent as flesh. These three stages may be obtained by changing the character of the discharge, due to the insertion in the discharge circuit of a variable resistance, thereby varying the frequency of oscillation. This simple expedient and the results derived from its use offer an explanation for the better effects that may be produced by the use of the so-called Tesla coil. Röntgen rays produced by tubes operated by such high-frequency discharges have a shorter wave-length, and therefore have, according to the Helmholtzian theory, a greater penetrative power than when such coils are not used. It is evident that with proper facilities for changing the frequency of discharge, Röntgen rays may, within limits, be produced having any desired wave length. It would be exceedingly interesting in this connection to determine what effects may be produced by a high potential non-oscillatory discharge such as may be obtained from a few thousand small voltaic cells. If the above theory is correct, no Röntgen-ray effect should be expected. As pointed out by Mr. Porter, the insertion of a resistance, such as a wet string in the discharge circuit, produces an effect similar to that obtained when heat is externally applied to the surface of the tube. In this connection it is interesting to note the experiments of Mr. C. L. Leonard, described elsewhere in this issue. Although this paper shows no phenomenon of Röntgen rays not previously described, a fact, however, not to be inferred from its title, there are several results pointed out, which if not novel, have apparently an important bearing upon the most efficient method of producing Röntgen rays. Mr. Leonard believes that he has succeeded in separating Röntgen rays from the Lenard rays, and has shown thereby the necessity of maintaining this separation in order to obtain the best Röntgen ray effects. There is little doubt that the static charge on the surface of the tube plays an important rôle in its operation, and that by changing its distribution by such means as Mr. Leonard has employed will materially alter the effects produced. The residual gas within the tube will be most dense at that part of the tube where the static charge is located, so that if this charge is altered, either by means of a flame or a conductor, the residual gas will change in density. It will be only by careful study of these phenomena that the most effective means of producing Röntgen rays can be determined.

The Temperature of Incandescent Lamp Filaments.

In our Paris notes of last week reference was made to a method of measuring the temperature of incandescent lamp filaments as employed by M. Janet. In a communication to the Académie des Sciences and published in *Comptes Rendus*, No. 18, of the current volume, M. Janet gives more explicit details of the method employed. The method is based upon the experimental results of M. Violle, who has determined the mean specific heat of carbon between zero degrees and 1000 degrees C. If E be the applied potential difference at the lamp terminals, by varying E both the resistance and temperature will vary. A curve may be plotted by using the resistance R as abscissæ and E^2/R as ordinates where E^2/R is the loss in radiation at any temperature θ. By employing a lamp under normal conditions and interrupting the current at a specified time the variation of the resistance of the filament may be observed as the filament cools. A second curve having the time as abscissæ and the resistance as ordinates may be plotted. A third curve may be derived from the first by using the time as abscissæ and the loss due to radiation at each instant as ordinates, the area of which curve will give the total loss due to radiation through the range of temperature employed and by dividing by the mechanical equivalent of heat, the corresponding quantity of heat may be obtained. Assuming the filament to be of pure carbon, it is weighed and M. Violle's formula applied. M. Violle found that (*a*) above 1000 degrees C. the mean specific heat of graphite may be expressed thus: $C_0^t = 0.355 + 0.00006 \times t$, where t is the time. (*b*) The heat given off by one gramme of graphite, between the temperature of volatilization and zero degrees centigrade, is 2050 calories. Therefore the boiling point of carbon is 3600 degrees C.

The English Institution of Electrical Engineers.

As our readers will remember, this institution has, during the past twelve-month, been in the throes of a series of crises, culminating in a complete revision of the Articles of Association. According to our English correspondent, one of the most important of these revisions is that which curtailed the voting power of the past presidents, who, some 13 in number, formed a sort of House of Lords, and by the dead weight of their votes vetoed anything in the nature of a progressive move. A corollary of these alterations was the increase in the numbers, influence and vitality of the ordinary Council. The Council has been made larger, and will in the future be rapidly renewed, and owing to the early publication of the proposed names, greater opportunities are afforded members to add desirable names and to ensure the election of the gentlemen thus selected. The president for the year 1897 is Sir Henry Mance, well known in submarine telegraph circles, the vice-presidents being Mr. R. Kaye Gray, of Silvertown; Prof. Silvanus P. Thompson, Prof. Perry and Mr. Swan. Of the 15 ordinary members of the Council no less than nineare new, and among them are found the names of the presidents of the two rival institutions, *viz.*, the Northern Society of Electrical Engineers and the Municipal Electrical Association.

On the Mode of Transferring Energy in the Electric Circuit.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

When the electric activity of a circuit is spoken of as being $e\,i$ watts, where e is the voltage and i the amperage at the point considered, it is understood that this is the rate at which energy is transferred along the circuit past that point. Thus if an overhead telegraph wire with ground return extends from New York to Philadelphia, a dynamo being connected to the wire at New York, and an observer at any point, say at Trenton, finds a steady current of 0.05 ampere flowing through the line at a pressure of 50 volts, he knows that energy is being transferred along the line at Trenton toward Philadelphia at the rate of $50 \times 0.05 = 2.5$ joules per second, or 1.845 foot-pounds per second, and this energy is taken from the engine driving the dynamo in New York. It is now almost universally admitted that this energy is transmitted not through the wire, but through the ether surrounding the wire, and Poynting has shown that the vector transfer rate of energy per square centimetre at any point in space surrounding the wire is the vector product $\frac{E\,\mathfrak{H}}{4\pi}$ ergs, where E is the vector electromotive intensity in C. G. S. magnetic units and $\mathfrak{H}$ the vector magnetic force in C. G. S. magnetic units.

So far as we are aware, the mechanism by which this energy is transmitted along a circuit is not explained in text-books or works on physics. It is understood in a general way that the energy is transmitted through the ether in a direction and at a rate defined by Poynting's law above stated, but the rationale of the process is not explained. We think that we can offer a suggestion as to how the transfer may take place, not merely under the general formula of "motion of Faraday tubes of force through space" but concretely by the use of the more fundamental conception of the energy resident in electrostatic flux. Our idea is that the rate of transfer of electromagnetic energy past any point of an active conductor is the rate of transfer of the electrostatic flux multiplied by its contained electrostatic energy, together with the magnetic energy which that moving electrostatic flux generates and carries with it. In other words, that the activity at any point of a circuit or the energy transferred per second is equal to the sum of the electrostatic and magnetic energies sweeping past that point in each second.

Thus, in the case above considered, the observer at Trenton could determine, from the geometrical disposition of the telegraph wire relatively to the ground, the electrostatic flux distribution surrounding it. He could map out, theoretically, the curves of electric displacement emerging from the wire and terminating in the ground or at the surfaces of surrounding objects, considered to form part of the ground. From this distribution he could find the electrostatic flux density or "number of electric unit lines of displacement per normal square centimetre" at every point, and determine the electrostatic energy in each cubic centimetre of the space in the neighborhood of the wire. If we suppose that this usually most complex operation could be performed, he could sum up and determine the total amount of electrostatic energy contained between two parallel vertical planes, one centimetre apart, intersecting the wire perpendicularly. Thus he might find that at Trenton between two such planes the total electrostatic flux energy might be 500 ergs.

If the telegraph wire were open-circuited at Philadelphia and perfectly insulated all along the line, this energy must be considered to reside permanently between the two imaginary vertical planes, bound up in the ether as electrostatic energy, whatever that may be, and if we could lay hold of the energy and mark it we should expect to find it quiescent between these planes so long as the conditions of the dynamo and insulated line remained unchanged. No current flows from the dynamo, but when the line was first charged the electrostatic flux brought with it 500 ergs from the dynamo into the space between these two planes, and during the movement of the flux in process of charging a brief electric current was sent from the dynamo.

If, however, the telegraph line be grounded at Philadelphia, the voltage at Trenton might still be adjusted to the same amount by raising the pressure at New York, and still give 500 ergs of electrostatic energy between the two unit distant infinite vertical planes intersecting the wire, but we are now confronted with a kinetic instead of a statical problem, and we have the electrostatic flux in rapid movement over the wire instead of at rest. The energy between the planes is constant, but if the energy were marked we might expect to see it running through the ether in a direction nearly parallel to the wire at the velocity of light and bound up with the moving electrostatic flux, so that when the electrostatic flux moves the energy moves along with it. Consequently each pulse or wave of electrostatic flux carries its associated energy.

But the movement of electrostatic flux through ether is understood to develop a magnetic force in the ether across the flux and the motion. This magnetic force establishes locally a distribution of magnetic flux which also contains energy. The amount of the magnetic energy at any point is known to be equal to the electrostatic energy in every electromagnetic wave. Consequently, as soon as electrostatic flux is set in motion as a single pulse or wave it divides its energy, half becoming magnetic and half remaining electrostatic.

In any circuit carrying a steady current according to Ohm's law, this current is the resultant of a number, usually a great number, of successive electric waves which have become added, reflected and at the same time attenuated, as they run around the circuit, so that the electrostatic flux, the magnetic flux and their energies at any point are the algebraic sums of the quantities in the respective waves.

We may, however,* in order to simplify the discussion, eliminate the summation difficulty, by confining our consideration to a circuit—the distortionless circuit of Heaviside—in which only a single train of waves flows over the circuit, so that the first wave is the only wave which counts, no reflection taking place.

Consider any uniform circuit in which

r = the resistance of the circuit per cm, C. G. S. magnetic units.
l = the inductance of the circuit per cm, C. G. S. magnetic units.
g = leakage conductance of the circuit per cm, C. G. S. magnetic units.
c = the capacity of the circuit per cm, C. G. S. magnetic units.
u = the steady potential difference in the circuit at any point of the circuit per cm, C. G. S. magnetic units.
i = the steady current strength in the circuit at the same point of the circuit per cm, C. G. S. magnetic units.
v = the velocity of light in the dielectric, cms per second.

Assume $\frac{r}{l} = \frac{g}{c}$ to obtain a distortionless circuit. Then Heaviside has shown that with suitable terminal conditions at the receiving end there will be only one wave train in the circuit when a steady E. M. F. is applied at the transmitting end. Also that this wave train has at every point the velocity v, while the current and pressure are so related that $i = u\,c\,v$ everywhere.

Select a point in the circuit where the pressure is u and the current i, then the quantity of electricity q in a centimetre length of the circuit is $q = u\,c$ C. G. S. magnetic units.

This represents an amount of electrostatic energy:

$$w = \frac{u\,q}{2} = \frac{u^2\,c}{2} \text{ ergs per linear cm of dielectric.}$$

But the electrostatic flux is moving on past the point at a velocity v cms per second, so that the total electrostatic displacement flux which passes per second is $v\,q$, carrying a total amount of electrostatic energy $W = v\,w = 1/2\,u^2\,c\,v$ ergs in each second, representing an electrostatic transfer activity $p = \frac{1}{2}\,u\,c\,v$ ergs per second. But the activity in the circuit at the point considered is

$P = u\,i$ ergs per second.
$= u\,u\,c\,v$ ergs per second.
$= u^2\,c\,v$ ergs per second.

or $P = 2\,p$.

In any electric wave or succession of waves the energy as already stated, is half electrostatic and half electromagnetic. Consequently the activity in a distortionless circuit is half composed of the electrostatic energy carried by and bound up in the electrostatic flux, and half of the magnetic energy bound up in the movement of the flux.

If then we consider any electric circuit as the seat of electric flux moving with the velocity v, but subject to reflections and absorptions, we obtain a total flux movement, or electric current along the circuit, which is the sum of a series of successive waves. The activity at any point in the circuit, expressed as $e\,i$ joules in each second of time, will be the sum of the electrostatic energy carried

* This is independently proved as follows: The electromagnetic energy in a linear cm at the point considered is

$$w_m = \tfrac{1}{2}\,l\,i^2 \text{ ergs, but } l = \frac{1}{c\,v^2} \text{ and } i^2 = u^2\,c^2\,v^2 \therefore w_m = \tfrac{1}{2}\,u^2 c.$$

This energy runs by in v centimetres each second, so that the total electro magnetic energy of transfer in a distortionless circuit is

$$p_m = \tfrac{1}{2}\,u^2\,c\,v \text{ ergs per second} = \frac{P}{2}.$$

past the point per second plus the sum of the magnetic energy associated with the moving electric flux

From this point of view the greater power of a high-pressure circuit compared with a low-pressure circuit carrying equal current strength is directly traceable to the increased electrostatic flux energy.

Corrosion Caused by Railway Return Currents.

BY DUGALD C. JACKSON.

In 1894 I presented before the Western Society of Engineers* the results of the investigations in the electrical laboratory of the University of Wisconsin upon the processes brought about by the return currents of electric railways, which cause corrosion of iron pipes that lie in the path of the currents. The panicky condition at that time existing among electric railway managers and the owners of underground pipes and cables (caused by exposures of the extent of the trouble which had been and which might still be brought about by electrolysis due to railway return currents) has been allayed by means of a reasonable examination of the subject, while reasonable precautions against electrolysis have been quite generally taken in this country, so that the dangers from its effects, which were originally pronounced by some to be unavoidable, have been in practice reduced to a reasonably negligible minimum.

As the effects of electrolysis must be continuously guarded against, the subject is still of sufficient interest to warrant detailing the results of experiments to determine the differences in the reactions which occur when lead and iron are respectively the metal of the anode upon which the corrosion takes place. These experiments were carried out during the Winter of 1895-6, by Messrs. Scott and Van Ness, in the Wisconsin University laboratory. The experiments of two years earlier, carried out by Messrs. Biefield and Silber, and referred to above, were made the foundation of the new work, but lead anodes were used instead of iron, the cathodes being of iron in both sets of experiments.

The problem set before experimenters was :

1. To determine the character of the chemical action set up by electrolysis between a lead anode and an iron cathode under the conditions that occur in the ground where corrosion occurs to lead pipes or cable coverings by the electrolytic action of railway return currents.

2. To determine the rate of corrosion.

3. To compare the chemical reactions and the rate of corrosion when the anodes are respectively of iron and of lead.

The results of these experiments fully substantiate the deductions drawn from the original experiments carried out by Biefield and Silber. The chemical reactions occurring during electrolysis with the lead anode are exactly such as would be inferred from the earlier experiments ; and the corrosive action is again proved to be uninfluenced by the actual E. M. F. applied, except as this controls the amount of current flowing, so that the rate of corrosion is alone dependent upon the amount of the current flowing within the critical amount and the nature of the salt composing the electrolyte. The following table (Table I.) gives the averages of three runs with electrolytic cells having lead anodes, iron cathodes and an electrolyte composed of sand moistened with various salts:

TABLE I.

Electrolyte. Sand moistened with	Loss per ampere-hour. Grams.
Sodium nitrate,	4.10
Ammonium nitrate,	3.82
Potassium nitrate,	4.38
Sodium sulphate,	2.18
Sodium chloride,	2.09
Ammonium chloride,	2.12
Potassium chloride,	1.89
Sodium carbonate,*	1.20
Ammonium carbonate,*	1.14
Average of nitrate salts,	4.10
Average of sulphate salts,	2.18†
Average of chloride lts,	2.03
Average of carbonate salts,	1.17

* Only one run. † Only one salt (sulphate of soda) tested.

In each run the order of activity of the salts was nitrates, sulphates, chlorides, carbonates. A comparison of these results with those of the earlier experiments, where iron anodes were used, shows that the order of activity of the salts is different for the two kinds of anodes, as would be expected from purely chemical considerations. The order of activity found in the earlier experiments using iron anodes was chlorides, nitrates, sulphates. The following table (Table II.) shows the average losses at the anode per ampere-hour, according to the two sets of experiments. The loss is considerably greater in each case with the lead anodes, as would be expected.

TABLE II.

Salt.	Lead anode.	Iron anode.
Nitrates,	4.10	.89
Sulphates,	2.18	.66
Chlorides,	2.03	1.33
Carbonates,	1.17	.00

The results of these experiments, which were carried to too great a length to detail fully, lead to conclusions which are virtually a paraphrase of the conclusions based on the earlier set of experiments with iron anodes and which were previously published :

1. The destructive corrosion of the anode is due to secondary chemical reactions brought about by the electrolysis of some salt held in solution by the water of the soil, and not by direct oxidation resulting from the electrolysis of water.

2. Corrosion takes place wherever a current is leaving the pipe or cable covering, however small the difference of potential may be; and the rate at which lead is removed from the pipe or cable covering is dependent solely upon the strength of the current and the nature of the salts present in the soil about the pipe or covering.

3. A very small quantity of the salt is sufficient to start the action when a current flows, and the chemical reactions are regenerative and continue as long as the current continues to flow.

4. Corrosion will occur with the smallest possible difference of electrical potential, provided the earth's resistance permits any current to flow.

In my previous paper upon this subject (two years ago) I presented certain recommendations based upon the results of experiments and upon experience with electric railway circuits which, if followed in the construction and operation of such circuits, would prevent dangerous corrosion. Many electric railways made use of the suggestions, and a satisfactory evidence of their utility is presented in a pamphlet on "Electrolytic Deterioration of Water Pipes," lately issued by the National Board of Fire Underwriters, which contains virtually similar recommendations apparently based upon the results attained during the interval which has elapsed, in which an effort has been made to apply preventive measures against destructive corrosion.

* *Journal of the Association of Engineering Societies*, Vol. XIII., p. 509; THE ELECTRICAL WORLD, Vol. XXIV., p. 144.

Preliminary Report of the Committee on a National Code of Rules.

At the joint conference of electrical, insurance and allied interests looking toward the adoption, promulgation and enforcement of a national code of rules for electrical construction and operation, which was held March 18 and 19 of this year at the headquarters of the American Society of Mechanical Engineers, New York City, a large amount of work was done, and after a permanent organization to be known as the "National Conference on Standard Electrical Rules" had been effected with headquarters at 12 West Thirty-first Street, New York, it was decided to place the work of drafting the final code in the hands of a committee of eight, including the president *ex-officio*, which committee was to report back to the next meeting of the national conference. This committee consisted of the following gentlemen:

Prof. Francis B. Crocker, chairman, delegate American Institute of Electrical Engineers. Frank R. Ford, secretary, delegate American Street Railway Association. William Brophy, delegate National Electric Light Association. William H. Merrill, Jr., delegate National Board of Fire Underwriters. E. A. Fitzgerald, delegate Underwriters' National Electrical Association. Alfred Stone, delegate Ameritan Institute of Architects. E. V. French, delegate American Factory Mutual Insurance Company. W. J. Hammer (*Ex-officio*).

This committee has recently met in New York and spent two days upon the preparation of the code, and then adjourned to meet again Dec. 11 and 12, this date being decided upon in order to enable the Underwriters' National Electric Association, which meets in this city Dec. 8 and 9, to consider the suggestions already made by the Code Committee, to secure their criticisms and co-operation in the matter. It is expected that shortly after the next meeting of the Code Committee that the National Electrical Conference will be called to take action upon the code prepared by the committee.

It is very gratifying to observe that the various engineering societies, and the strong representation of the insurance organizations represented in the National Electrical Conference, are working so harmoniously and with so much energy to bring about the long wished for and much to be desired single national code of rules.

Niagara Power Transmission Up to Date—III.

CATARACT POWER FOR STREET RAILWAYS IN WESTERN NEW YORK.

BY FRANK C. PERKINS.

THE Niagara Electro-Chemical Works are now being supplied with current by the Niagara Falls Power Company, and after the present works are enlarged more power will be required. The works consist of several large brick buildings covering 75,000 square feet of space. The new building is 140 feet wide and 160 feet long. The special machinery used in this building is for the manufacture of sodium, the details of which process cannot be given. The boiler house is 40 feet wide and 67 feet long, and the transformer house and office is a two-story brick building, having a frontage of 80 feet on Buffalo Avenue on the Niagara Falls Power Company's land. The construction was by Rogers & Co., and the plant has but recently been put in operation. The Niagara Electro-Chemical Company is controlled by Hasslacher & Co., of New York, the officers being Franz Roessler, president and treasurer; Hamilton V. Castner, vice-president, and Jacob Hasslacher, secretary and manager. The works were established in 1895 with a capital of $100,000, for the purpose of manufacturing sodium from caustic soda and peroxide of soda under the Castner electrolytic process. The works are at present using 500 horse-power, which will be increased by one or more units of 250 horse-power each. The current received from the Niagara Falls power-house is not adapted for use in the electrical manufacture of sodium, being an alternating current of 2200 volts. There are therefore in the transformer house four static transformers, which reduce two-phase alternating current from 220 volts to 118 volts. These machines are connected by cables which are carried in the underground subway to the power-house of the Niagara Falls Company. They are supplied from the same feeders as the Aluminum Works and the other chemical works. The beginning of the subway and cables starting in the power house may be seen in one of the accompanying illustrations. There are two rotary transformers of 250 horse-power each, which machines were installed by the Westinghouse Electric & Manufacturing Company. The rotary transformers shown in one of the illustrations transform a two-phase alternating current as it is received in the static transformers at 118 volts to a direct current of 116 volts, and it is then conducted to the main switchboard which is also shown. From this switchboard feeders lead to the various machines where the current is used for the manufacture of sodium.

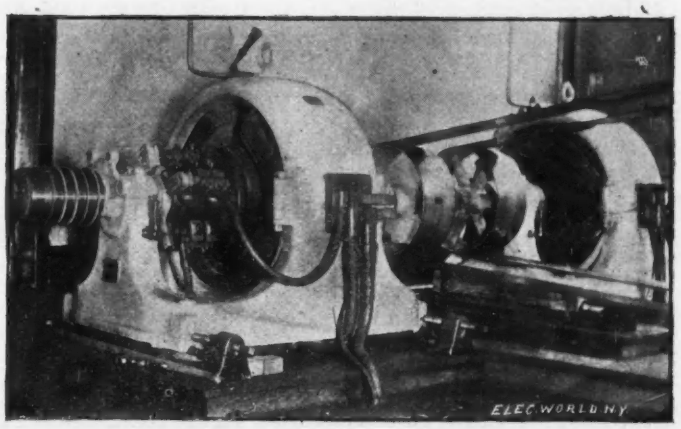


FIG. 1.—30-KW ROTARY TRANSFORMERS IN BUFFALO REAL ESTATE EXCHANGE.

BUFFALO–NIAGARA POWER TRANSMISSION.

The Buffalo Real Estate Exchange was recently equipped with electrical apparatus with the view of utilizing electrical power from Niagara as soon as possible. The plant and switchboard, and in fact the entire electrical equipment, was installed by F. P. Jones & Co., of Buffalo.

The two rotary transformers seen in one of the illustrations were built by the Westinghouse Company and have a capacity of 30 kilowatts each. They are at present operated by steam engines and used as dynamos, delivering current for the general lighting of the building. As soon as it is possible to get Niagara current transformed static transformers are to reduce the current to the proper voltage, then the rotary transformers will convert it from a two-phase alternating to a direct current of the same potential now being used.

The Real Estate Exchange is not the only building equipped for utilizing Niagara power. The works of Plumb, Burdick & Barnard are equipped throughout with Tesla motors, varying from 2 to 50 horse power, many of the machines being already connected. At the present time a Green steam engine drives an alternator which supplies the current for operating these motors. As the works are directly upon the line of the Niagara power transmission they will soon be operated from the power of the cataract.

The transformer house of the cataract power-house is located on the opposite side of the inlet canal and the main power house-building is connected to it by a stone conductor bridge, the interior of which, showing the cables, was illustrated in THE ELECTRICAL WORLD of Nov. 21.

The current conveyed to the static transformers across this bridge by means of the cables shown is a two-phase alternating current of 2200 volts supplied by one of the 5000-hp generators. The illustration shows how they are carried on the sides of the subway from the generator on the left. On leaving the conductor bridge the cables are conneeted to the static transformers from below through the switchboard, which occupies a position on the left of the transformers as indicated.

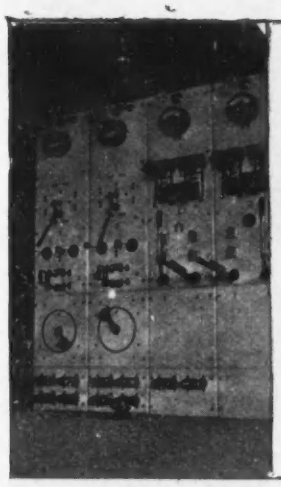


FIG. 2. — SWITCHBOARD FOR ROTARY TRANSFORMERS.

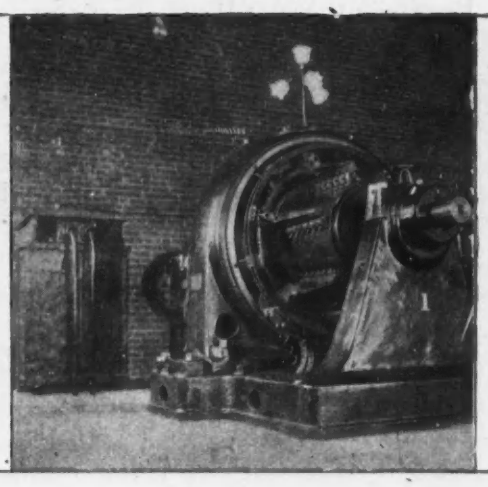


FIG. 3.—STATIC AND ROTARY TRANSFORMERS, 250 KW EACH, 2200 VOLTS, ALTERNATING TO 116 VOLTS, DIRECT-CURRENT.

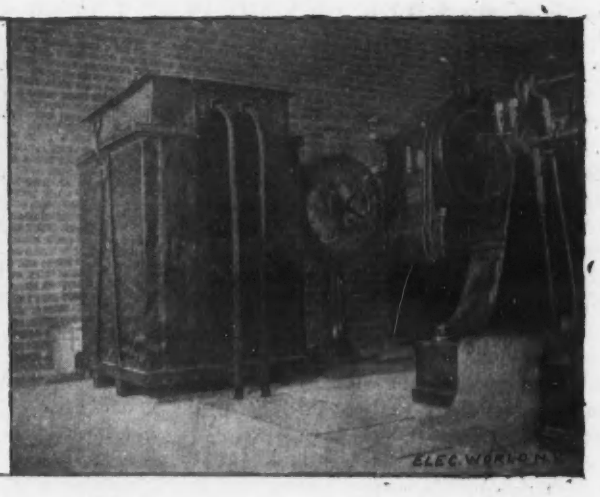


FIG. 4.—STATIC TRANSFORMER. 2200 VOLTS, TWO-PHASE, TO 118 VOLTS, DIRECT-CURRENT.

APPARATUS IN NIAGARA ELECTRO-CHEMICAL WORKS.

It is a two-phase alternating-current switchboard of blue Vermont marble and has four single-pole switches on the upper part. The two-phase current at 2200 volts is then transformed to a three-phase current of 11,000 volts at the static transformers and is then conducted to the three-phase alternating switchboard, which is also of blue Vermont marble.

The static transformers are two in number and are mounted on an iron framework about eight feet from the cement floor of the transformer house. These transformers each have a capacity of 1250 horse-power and the expectation is to increase the number as rapidly as needed, the necessary space and arrangements having already been provided. The transformers are built with air-tight compartments below them, and the air is forced through by means of blowers, the amount being regulated by dampers fixed to the transformers themselves. The 5-hp motor operating a large centrifugal blower is shown in one of the illustrations. By means of this forced air circulation the efficiency of the transformers is kept very high, exceeding 98 per cent. and they are at the same time kept absolutely cool even at full load, the temperature elevation not exceeding 40 degrees C.

In the pit below the transformers there is an abundance of room to walk about, and the connections are very easily made or broken at will. The lightning arresters are similar in design to those shown in the illustration of the Buffalo arresters and are located near the point where the cables leave the transformer house and are connected to the Buffalo line. The cables from the transformers are mounted on porcelain insulators supported by iron brackets. The illustration shows the method of mounting in the subway of the transformer house before reaching the wood lightning arresters. The insulators are of the triple-petticoat type and were tested up to 50,000 volts, many puncturing at that voltage, particularly where flaws occurred in the glazing, but a perfectly glazed insulator always withstood the test.

There are several styles of insulators in use. The Niagara type was made by the Imperial Porcelain Works at Trenton, N. J.

After leaving the transformer house at Niagara Falls bare conductors are used and the current is thus conducted on an overhead pole line to the terminal house at Buffalo city limits. From the terminal house on the left bank of the canal, the conductors are carried underground after passing a set of single-pole switches in the building. From the terminal house the conductors, which are lead covered, pass through a conduit under the tow path of the canal to the transformer house of the Buffalo Street Railway Company.

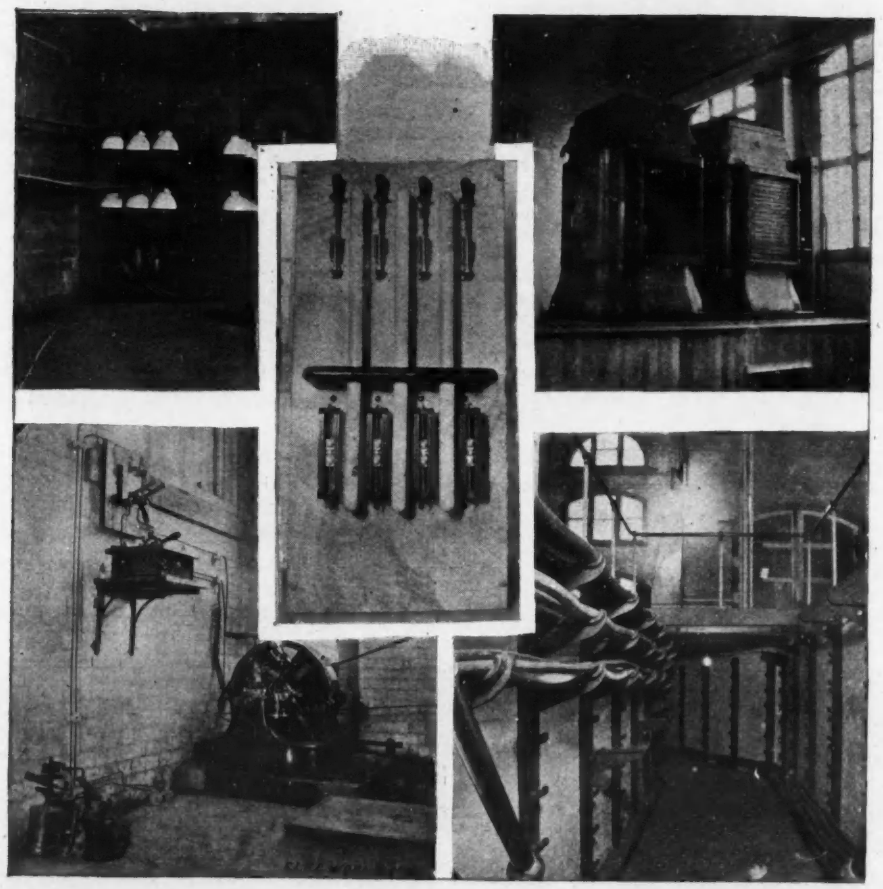


Fig. 5.—Beginning of Subway in Transformer House. Cables Carrying 3-Phase Current to Buffalo Line.

Fig. 7.—2200-Volt Two-Phase Switchboard. High Tension Fuses Below.

Fig. 6.—Centrifugal Blower Motor for 1250-hp Transformers.

Fig. 8.—Two 1250 Horse-Power, Three-Phase 11,000-Volt Transformers.

Fig. 9.—Beginning of Subway Carrying 2200-Volt 2-Phase Current from 5000-hp Generators, Niagara Power-House.

THE BUFFALO STATIC TRANSFORMERS.

The transformer house of the Buffalo Street Railway Company is located at the rear of the main power-house and is partially underground. The conductors enter the transformer-house from beneath the static transformers and are carried above them. The lightning arresters are shown in one of the accompanying illustrations and the connections to the transformers on the left. The three static transformers are mounted upon a framework similar to that at the Niagara transformer house, a space being left below the floor which is made air-tight and supplied by a 60-inch centrifugal blower. Air spaces are left between the laminations of the iron through which the air also passes. This method of cooling is neat and clean and seems to be far better than any other suggested as the air, which is forced through the transformers, comes in direct contact with the coils and laminations. The insulation of the coils is very good and the arrangement of them is such as to give the best protection against puncture.

The three static transformers each have a capacity of 350 horse-power and the weight of each is over 7000 pounds. They have an efficiency of 98 per cent., and the temperature is not allowed to exceed 40 degrees centigrade. The transformers are 6 feet 9 inches high and each occupies a floor space of 4 square feet, or a total of from 12 to 15 square feet.

The three-phase alternating-current switchboard shown in one of the accompanying illustrations is similar to the three-phase board at the Niagara transformer house. It is made of blue Vermont marble, and upon it are mounted three large single-pole switches. The current is conducted by six cables to the rotary transformers in the power house. These cables together with an electric motor for driving one of the blowers is to be seen in one of the accompanying illustrations. The three-phase current on arrival at the transformer house has a potential of a little more than 11,000 volts, and is transformed down to a low-pressure three-phase current and then through the rotary transformers to a current suitable for use on the street railway lines. Both rotary transformers have been in use since making the test and have given good satisfaction. They have been operated in parallel with old Edison bipolar generators which was a severe test. The rotaries have been operating the entire line during the night when the load was within their capacity, which is 1000 horse-power.

The Cold Spring and several other lines have been operated continuously up to the present time by the Niagara current, thereby showing that the Buffalo-Niagara transmission is a complete success. The Hon. Caryl Ely stated that the Buffalo & Niagara Falls Electric Railway Company was now operating the whole length of the line with Niagara current. It is the intention of the company, he said, to install a sub-station located midway between Buffalo and Tonawanda, which are 10 miles apart, and that in this station static and rotary transformers will be used for producing a 500-volt direct current. This will reduce the loss on the line and allow very much greater traffic with the present capacity of the feeders.

There is little doubt but that when the Buffalo Traction Company begins operations in Buffalo Niagara power will be used by this company also.

The Cadmium Cell Found Superior to the Clark Cell.

The low-temperature coefficient of 0.004 per cent. per degree and E. M. F. of 1.019 volts at 20 degrees C. of the cadmium cell makes it, in the opinion of Herr Kahle, as reported in *Wiedemann's Annalen*, No. 11, superior to the Clark cell.

New Physical Phenomena of Röntgen Rays.*

BY CHARLES LESTER LEONARD.

The physical phenomena connected with Röntgen rays are at present limited to those announced by their discoverer, Prof. Wilhelm Konrad Röntgen, viz.: Their power to penetrate substances formerly considered opaque; their chemical action exhibited upon the photographic film and fluorescent screen, and their power of discharging electrified bodies whether positively or negatively charged.

The simple experiments which I conducted at the Pepper Laboratory of Clinical Medicine, seem to prove that another physical characteristics of Röntgen rays is now known.

In heating a double cathode tube of the focus type, while it was energized by an alternating current, the following phenomenon was noted. When the lamp was held at a point midway between the cathodes and at a distance varying from one-half to three inches from the tube opposite the reflectors, Röntgen rays, as shown in the fluoroscope, and the fluorescence within the tube were seemingly extinguished. This was true in tube *A*, and in no other tube of the double cathode focus type.

In the following experiments I was assisted by Mr. Alfred Watch.

Basing our experiments upon the theory that it was the aqueous vapor, produced by the combustion of the alcohol, which caused this phenomenon, we substituted for the alcohol lamp a small piece of filter paper saturated with water and obtained the same result. There was no effect upon the other tubes, the discharge of Röntgen rays and the fluorescence remaining unaltered. On approaching the wet paper to the cathode a streaming of electricity was observed from the paper or lamp vapor toward the cathode through the wall of the tube, and was observed to diminish in quantity as the paper was carried toward the point midway between the cathodes and opposite the reflector. When it reached this point the Röntgen rays and fluorescence ceased. At all points outside the tube a grounded wire drew a spark from the burner of the lamp or from the moistened paper. This experiment seems to show that there can be established outside of the tube a connection between one cathode and the other, capable of modifying the effect of the electrical discharge within the tube. This was proved by using a piece of wet paper so shaped that it extended from cathode to cathode outside the tube. The Röntgen rays and fluorescence were seemingly destroyed in this manner in all forms of double cathode tubes used with the alternating-current. The form of interference which was first observed, was therefore the establishment of a path for the conduction of the electricity from cathode to cathode outside the tube, or, in other words, the completion of a short circuit between the cathodes in the induced electric field outside the tube.

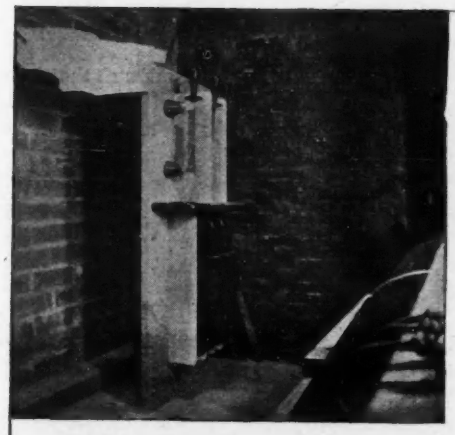


FIG. 10.—THREE-PHASE SWITCHBOARD. FUSES BELOW.

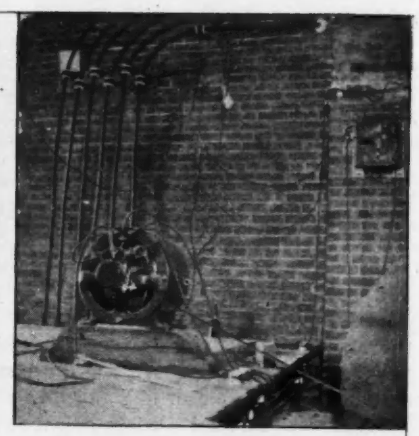


FIG. 11.—11,000 500-VOLT TRANSFORMERS, NIAGARA-BUFFALO TRANSMISSION.

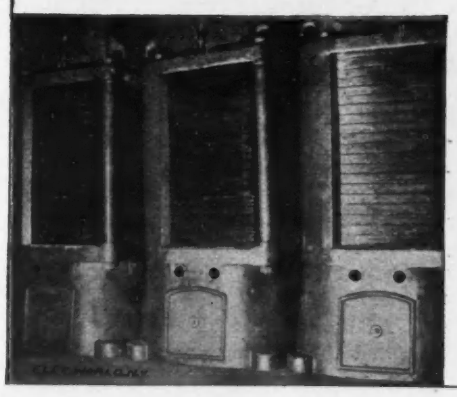


FIG. 12.—LOW TENSION 3-PHASE FEEDERS AND BLOWER MOTOR.

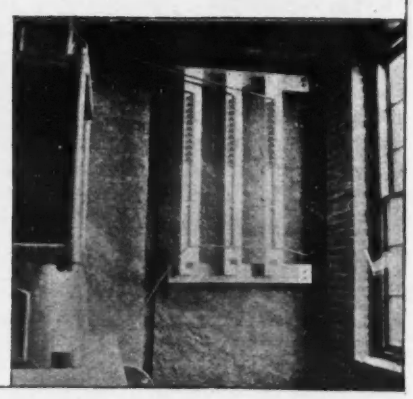


FIG. 13.—LIGHTNING ARRESTERS ON 11,000-VOLT CIRCUIT AND CONNECTIONS TO TRANSFORMERS.

A critical examination of two tubes of this type shows that in tube *A* the cathodes are in such relation to the planes of the reflector that light, obeying the law of reflection and emanating from the cathodes, would be reflected at such an angle as to leave a wedge-shaped area beneath two reflectors and between the two bundles of rays free from their interference.

An examination of tube *B* shows that no such area would be formed and that the two bundles of rays would be united in the median line.

The fluoroscope shows that this median area is the area of most intense fluorescence, as Röntgen rays enter it from both reflectors.

Suppose the rays obeying the law of reflection within the tube are the cathode rays, which become the Lenard rays outside the tube.

In tube *A* they would be reflected from the median line and leave a field of Röntgen rays free from their interference. We have then here a purer field of Röntgen rays, which would easily account for the greater rapidity and sharpness of definition which this tube has exhibited in contrast to other tubes used under the same conditions, and illustrated by the unintensified half-minute exposure negatives of the hand and other objects and the six minutes' exposure of the normal trunk of a five-year-old boy.

Would this supposition account for the absence of a conductive area midway between the two cathodes, which, when supplied by the aqueous vapor, results in the extinguishment of the Röntgen ray and fluorescence? It would, if we consider the Lenard rays to be capable of conducting electricity while the Röntgen rays are not. Under these conditions the aqueous vapor between the bundles of Lenard rays, in the case of tube *A*, would form the connecting link in the short circuit between the cathodes. If this theory is correct, how can we explain the difference in the phenomena observed in tube *B*?

In this tube we saw that the bundles of reflected Lenard rays occupied the median field beneath the reflector and were continuous, while the areas of non-conduction lay between the cathodes and the bundles of Lenard rays. By placing two small pieces of moistened paper in these two non-conductive areas, and thus supplying the conductor, the theory is proved to be correct, for the Röntgen rays and fluorescence are seemingly extinguished, and we have established the short circuit in both tubes through the medium of the Lenard rays and the aqueous vapor.

The following conclusions may be drawn from these experiments:

First: From the fact that a short circuit may be established between the cathodes, by placing an electrical conductor in certain positions outside the tube, not occupied by the Lenard rays, but occupied by the Röntgen rays, we may conclude that the Lenard rays are conductors of electricity, while the Röntgen rays are not. This will also account for the difference in the action of magnetic fields upon the cathode or Lenard rays and the Röntgen rays; and that action would confirm the deduction regarding the conductivity and non-conductivity of the two rays.

This deduction is also compatible with the phenomena observed in the discharge of electrified bodies by Röntgen rays, the ultra-violet rays and other forms of light rays.

Second: From the condition found to be present in tube *A*, that is, the presence of an area which is a non-conductor of electricity and is free from Lenard rays and *yet is* the area of most intense Röntgen rays, we may conclude that the latter emanate from the surface of

* Extract of a paper read before the American Philosophical Society, Nov. 20, 1896.

the reflector, in the reflector type of tube, and are not due to the bombardment of the tube by the cathode rays, as no cathode rays strike the wall of the tube in the area from which we find the greatest fluorescence.

Further, from the fact that Röntgen rays are non-conductors and are not influenced by a magnetic field, while the Lenard rays are conductors and are influenced by magnetic fields, it would seem probable that these two forms of radiant energy differ essentially in their character, the Röntgen rays presenting most of the phenomena characteristic of light, while the Lenard rays present the phenomena of radiant matter.

Third: From the difference in the rapidity of the action of the two tubes on the sensitive film, we may conclude that the presence of Lenard rays in a Röntgen-ray field interferes with the photographic action of the Röntgen rays. Consequently a tube of the greatest efficiency would be one so constructed that the Lenard rays would be reflected entirely outside of the most intense Röntgen ray field.

It would seem probable that the efficiency of the focus type of Röntgen ray tube is in a measure due to such a reflection of the Lenard rays, as many of those working with the single cathode focus tube have found that the point of greatest intensity of the Rontgen rays is not at the point where rays of ordinary light would be reflected if they emanated from the cathode—that is the point to which the Lenard rays are reflected—but is at a point perpendicular to the focal point of the cathode rays upon the platinum reflector.

Some New Electrical Apparatus.

BY REGINALD A. FESSENDEN.

I.—A New Tachometer.

In experiments with alternating currents the measurement of the speed of the dynamo is of the utmost importance. This is more especially the case where measurements are being made on circuits containing both capacity and self-induction, since the capacity required to annul any self-inductivity L is $1/C\omega^2$

This property is of considerable value in the design of speed regulators, such for instance as that shown in Fig. 1*A*, where 1 is an inductive coil of very low resistance, 2 a condenser of just sufficient capacity to supply the lagging current to the inductive coil at the required periodicity, 3 a coil in series with the main circuit, and 5 a coil across the terminals of the circuit and in series with the inductive coil 5. A copper disc placed inside the coils will move whenever the periodicity varies from that for which the condenser was chosen, and affords a very sensitive method of regulation.

In making measurements as above, however, this property is anything but convenient, as it causes an error in the final result proportional to the square of the error made in determining the speed of the dynamo. Consequently it is somewhat ludicrous to see, as the writer

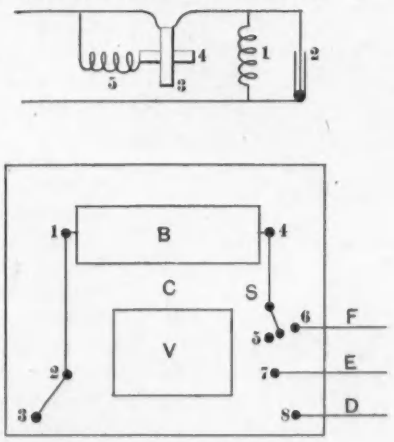


Fig. 1*A* and Fig. 1*B*.

has, experiments made in which the results were given to the fourth decimal place when the speed was not known accurately to within 2 per cent., and consequently the results might not have been accurate to within 4 per cent.

For such tests the speed indicator is of course worthless, as it only gives the average speed over a certain time. The ordinary tachometer is equally useless, as it is seldom accurate to within 2 per cent., and the readings are different when the speed is increasing from what they are when the speed is falling.

An improvement on these is Moler's speed counter. This prints the number of revolutions per minute, and by referring to the tape at the conclusion of the experiment the number of revolutions during the minute at which a particular observation was made can be found. This also, however, only gives the average speed during the minute, and in cases where, as in taking alternating-current curves by a contact method the reading depends upon the speed at one particular second it cannot give very accurate results. It would not show, for instance, whether an observation was taken at the instant when the joint in the driving belt was passing over the dynamo pulley, and this would affect the results very perceptibly.

A device which seems to have occurred to a number of electricians is that of using a permanent magnet and a revolving armature, the shaft of the armature being held against the dynamo shaft and the speed estimated by the voltage given by the armature. This idea occurred to the writer in 1888, but on mentioning it to Mr. Ayles-

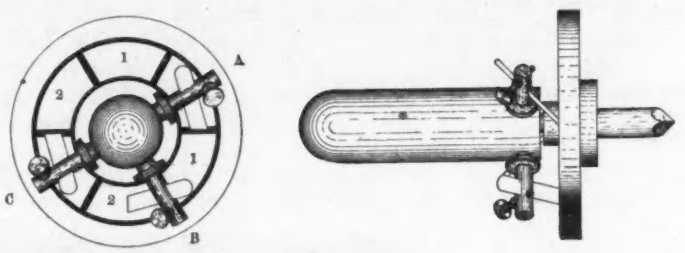


Fig. 2.

worth at that time it was found that he had also conceived the same idea previously. Mr. Wadsworth, of Chicago University, mentioned it to the writer in 1894, and still more recently Lieut. Squier has used the same device.

The writer, however, never actually constructed this form of instrument, from a fear that the proximity of the dynamo to the permanent magnets would change their moments, and so falsify the readings. I should say, however, after witnessing the performance of Lieut. Squier's instrument, that this error may not be so great as I anticipated.

The tachometer now to be described was constructed by the writer in 1894, and has proven a very valuable instrument. Its indications are absolute, and do not depend upon any assumptions, except that the capacity of a well-made condenser does not change to any great degree, and this has been proven by actual experience.

The method of operation is shown in Fig. 1*B*. A condenser C, a cell of storage battery B and a Weston voltmeter with double scale V are used. The cell and voltmeter are mounted on the board covering the condenser, which is of about two microfarads capacity; 1 and 4 are the battery terminals, 2 and 7 the terminals of the low-voltage coil, 2 and 5 of the high-voltage coil, and 3 and 8 the terminals of the condenser. The connections are as shown. S is a two-point switch, connecting 4 with either 5 or C as desired. D E F are the leads to the revolving commutator shown in Fig. 2, D in Fig. 1 B, connecting with B in Fig. 2, E with A, and F with C.

At the moment of using the switch S puts 4 in connection with 5, and the reading is noted. The resistance of the high-voltage coil is arranged so as to take about the same current when the battery is so connected as the low-voltage coil does when the commutator is running. This obviates any chance of varying polarization in the cell with different current strengths, though this is hardly necessary, as the currents taken from the cell are very small. The lower scale is so divided that when the commutator is revolving 10 times per second and the voltage of the cell is unity, the reading will be 100. It will therefore be seen that the reading of the cell direct on the upper scale gives the factor by which the reading of the lower scale, when the commutator is in use, must be divided by in order to get the number of revolutions per second. It is of course obvious that if a sensitive ballistic galvanometer were used instead of the Weston voltmeter a standard cell might be used and the scale of the galvanometer graduated to read direct.

I am at present trying to make up some cadmium cells about quart size, in the endeavor to obtain a standard cell capable of giving appreciable currents without polarization. If this succeeds, such cells could be used with the Weston voltmeter.

The commutator, as shown in Fig. 2, contains six segments. It is only 10 centimetres in outside diameter, and consequently very light. This is a great advantage, as in measuring the speed of small motors a tachometer, such as is ordinarily used, slows them down very considerably. The alternate segments are connected.

It will be seen from the connections that when the commutator revolves the condenser is first put in connection with the battery,

and then after one twelfth of a revolution, put in connection with the voltmeter. The discharge of the condenser through the voltmeter gives the needle a throw, and as the impulses succeed each other very rapidly the effect is a steady deflection, which, as explained above, when divided by the reading of the battery on the upper scale, gives the revolutions per second.

The instrument is very sensitive, changes of .1 of 1 per cent. being readily detected. Were the capacity of the condenser constant, the absolute accuracy would be of the same degree, but this

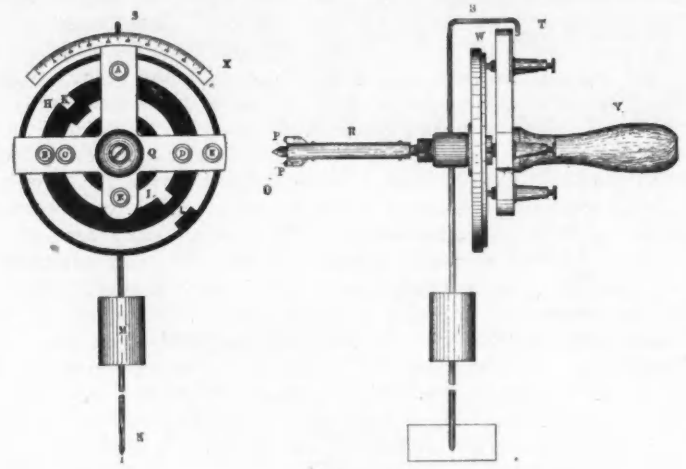


FIG. 3.

is not quite true, as it varies with time. This is however to a small degree, and the reading taken can be depended upon to $\frac{1}{5}$ per cent. after taking into account the temperature coefficient of the condenser and voltmeter. Without applying corrections its absolute readings may generally be relied upon to within about $\frac{1}{3}$ of 1 per cent. Of course by standardizing at the time of use, it can be relied upon to .1 of 1 per cent.

As might be expected from the behavior of the Weston voltmeter lighting circuits, every slight variation, such as that due to the passing of the belt joint over the dynamo pulley, is distinctly shown.

This instrument permits the reading of a speed at a distance from the observer. In the writer's laboratory the engines are several hundred feet from the instrument room, and when alternating current measurements are being taken the commutator is used in the engine room, and the condenser, voltmeter and battery near the observer, in the instrument room. This is more convenient, and the longer leads seem to make no appreciable difference.

The theory of the instrument is not quite so simple as the instrument itself, and it was only after a certain amount of consideration that it was decided that it would work.

In the first place, the condenser must be fully charged and discharged, even at the highest rate of speed of the commutator. Now, in a time equal to the time constant of the circuit, which is readily calculated for both the condenser, voltmeter and condenser-battery circuits, the charge or discharge remaining will be only one-third of the total charge. Consequently, care must be taken to see that unity divided by twice the number of commutator segments passed over by the brush per second is more than about 10 times the time constant for the circuit having the largest time constant, in this case that of the voltmeter.

Again, it might be supposed that the discharge through the voltmeter would set up eddy currents in the armature of the voltmeter (or in the copper supports for the coil, which is used in this special instrument). A little consideration, however, will show that since the rate of discharge does not depend upon the speed of the commutator, but only upon the time constant of the circuit, the effect due to this cause must always be in the same ratio to the force producing the throw, and this is found to be true on making the actual test. The instrument has now been in use for two years, and no fault has hitherto been found in its operation.

My thanks are due to Mr. Weston for mounting the coil of the instrument so that the motion is damped more than that of the regular Weston instruments, and to Mr. Brashear for constructing the commutator.

II. A NEW ALTERNATING-CURRENT CURVE TRACER.

The contact method of taking alternating-current curves, first used by Thomas at Stevens Institute, afterwards by Joubert, Ryan and others, has done valuable service, and has helped to elucidate many difficult problems. To obviate the slight uncertainty of the metallic contact Dr. Bedell has used a curve tracer in which a thin jet of water is cut at a definite point by a needle, and to obviate the polarization and capacity effects, which are very pronounced in this form of apparatus at low voltages, the writer has used a thin jet of mercury, which has given entire satisfaction.

An improvement on the above is Dr. Duncan's dynamometer method, which allows the readings to be taken very quickly and is in every respect an excellent method.

All these, however, are more suited for detailed scientific investigations than for commercial testing, as they require considerable time. It is not a slight matter to adjust the apparatus to a new machine, and it is doubtful if this can be done inside of half a day, and in some cases the dynamos have to be specially machined to permit of it.

The writer has designed an apparatus which can take curves from any dynamo, the only preparation needed being the making of two centre-punch marks on the shaft, and enables the readings to be taken as fast almost as they can be called off, (in actual test over 30 readings per minute). The description is as follows:

The rubber disc *W*, Fig. 3, has fixed on its surface two brass rings *H* and *J*. On the rings bear six pressure contacts *A*, *B*, *C*, *D*, *E* and *F*. The disc is driven by the spindle and this is attached to *R*. *S* is a pointer which hangs vertically, or nearly so, as it is kept thus by the weight *M*. The sleeve to which pointer and weight are fastened runs on ball bearings and no perceptible change from the vertical can be observed while the apparatus is running, though, as will be seen, even if there were a slight deviation it would not make any difference so long as it were constant. The rubber cruciform-arm *Q* is fastened to the handle *V*, in which the spindle runs. The six contact pieces which bear against the rings are pressed out by springs placed inside of the binding posts *A*, *B*, *C*, *D*, *E*, and *F*. The false point *O* slides in *R* and is pressed out by a spring. The scale *X* is fastened to the cross-arm *Q*.

In operation, a wire runs from the binding-post *A* to a condenser of about two microfarads capacity, another wire runs from *E* to one terminal of a Weston voltmeter with damped movable coil, (the same as used with the apparatus described above).

This makes contact at the gap *L* once every revolution. A wire runs from *B* to one terminal of the points between which the voltage is to be measured, and makes contact with the ring on the lug *K* once every revolution. As *A* is always connected with the ring *H*, it will be seen that the condenser is charged and discharged through the voltmeter once every revolution, the connection being as shown in Fig. 5, where the apparatus is arranged for taking simultaneously current and voltage curves from the primary of a transformer. *S* in the figure is a two-way switch and the other connections are as in Fig. 1, *B*. The result is a steady deflection on the voltmeter.

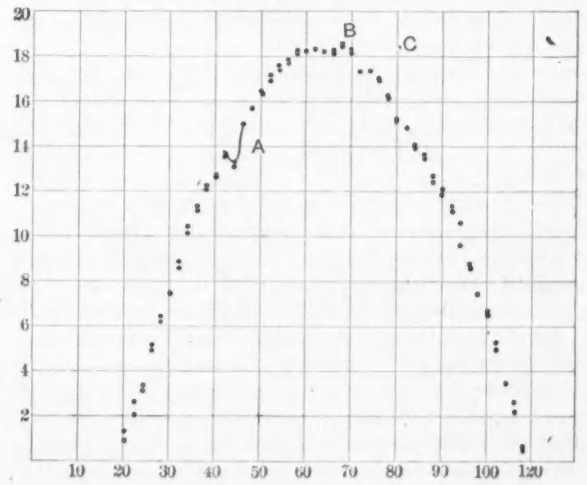


FIG. 4.

When it is decided to take a curve from a dynamo, the point of the spindle is held against the dynamo shaft and pressed in until the two points *P P* scratch a circle on the end. With a centre punch small holes are then made, on opposite ends of a diameter of the inscribed circle, so as to engage *P P*. The dynamo is then started up again and the false point *O* pressed in. This starts up the disc gradually, and when up to speed the spindle is then pressed in and the points *P P* engage. Holding the handle so that any desired degree on the scale is under the pointer the observer calls out the angle to his assistant, who notes the deflection on the voltmeter. The handle is then turned slightly till the next degree comes under the

point, and so on. The only limit to the speed is the time necessary to read the voltmeter and put down the numbers.

In order to damp vibration and swinging, since the needle would oscillate about five degrees otherwise, a copper vane is attached to the end of the weight *M*, and dips in a cup of cylinder oil. With this precaution, actual experience shows that the needle is perfectly steady, *i. e.*, no vibration amounting to one tenth of one degree is observable. This result was not anticipated and was very gratifying. There is no difficulty in reading to one fourth of one degree, and it might be made smaller if a mirror were fixed to the scale.

This method, of course, gives only comparative values, but the absolute values are readily found by attaching a cell of known voltage in place of the alternating-current source of potential.

Fig. 4 shows a curve taken by two students at the Western University, Messrs. Davis and Bright. Two readings are given for every angle, and the second set was taken without the observer knowing the corresponding figures of the first. Yet, though no special precautions were taken, it will be noted that the mean deviation was only twenty one one hundredths of 1 per cent., a remarkably small amount. I may say that the gentlemen who made the test had never taken any alternating-current curves before, thus showing that the manipulation of the apparatus is readily learned.

At one point in the curve, *A*, Fig. 4, a curious notch is noticeable. On looking at this, when the curve was handed me, I naturally supposed that this was due to a faulty reading, but it was pointed out to me by the observers that this was not only in both up and down curve but also in two other curves for voltage and current which had been taken at the same time. Suspecting this to be due to some fault in the apparatus I examined it, but was obliged to conclude that it was a real phenomenon. On examination of the machine, which was a two-phase, four-pole, rotary transformer, run from a storage battery, it was found that there was one high bar on the commutator and that the bar immediately following it was covered with a black deposit thicker than ordinary, due to the slight arcing, and that this notch occurred at the instant when the latter mentioned bar was under any one of the brushes.

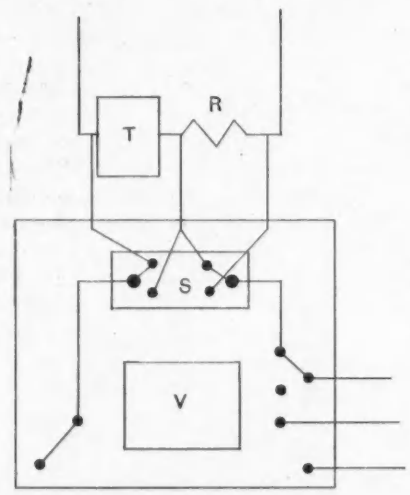


Fig. 5.

Though this rendered it probable that this bad contact at the instant succeeding the passage of the high bar under the brush was the cause of the sharp fall in voltage, I made a test myself, reading to quarter degrees, and found that the gap was real and invariably occurred about the same point, changing backward and forward about two degrees, however, probably as the contact on the low segment varied. These close readings led to the discovery that the true current curve had superimposed upon it a very small harmonic, whose maximum value was about ½ of 1 per cent. of the maximum ordinate of the fundamental and whose frequency was 163 times as great. This was traced to the teeth. I have not plotted them in the curve, however, as they would not show. The fact that the observations by which this was determined did not take 15 minutes will indicate the convenience of the apparatus.

Three difficulties might have been anticipated in the working of the commutator. The one most feared was the swinging of the weight, due to vibration and lack of parallelism between the axes of instrument and dynamo. This, however, unexpectedly turned out to be non-existent.

The second one was the fact that any slight play of the points *P P* in their respective holes would give rise to a relatively large angular displacement of the disc. Since this also gave rise to no trouble, as has been repeatedly shown by the agreement between separate readings and by the fact that both ends of the curve meet at the same point to one fifth of 1 per cent. of the maximum ordinate, it must be supposed that what we read is the average position, and that this average is constant.

A third question is whether the voltage of the condenser is actually that of the *A C* circuit being tested, at the instant that the contact *B* leaves the lug may not the charge in the condenser lag behind the true voltage? It is an easy matter to work this out mathematically, but though simple it is tedious and unnecessary, for on writing out the expression it will be found that the terms which would produce error are exponetial and contain the time constant. They vanish after a time equal to 10 times the time constant.

Now the condenser has a capacity of about two microfarads, and the resistance of the *A C* circuit concerned is not generally more than one ohm. Consequently the time constant for the circuit is about .000002 seconds, or the effects will vanish after .00002 seconds.

During this time, if we assume 10 revolutions per second of the commutator, the disc will have moved through about one-twelfth of one degree. So it will be seen that this effect is negligible.

The current flowing through the instrument is very small, and calculation shows it does not affect the circuit tested appreciably, and the presence of the condenser in the circuit may be shown to be similarly without measurable effect. This is, of course, when circuits are measured containing at least one quarter ampere of currents or else such that the instrument is used across only a portion of the total voltage. These conditions are, however, generally met with in practice. In other cases, however, an electrostatic voltmeter may be used instead of the Weston instrument.

By means of the second disc *f*, a second curve can be taken at the same time, using the Weston instrument with a two-way mercury switch. Thus curves of current and voltage, or both curves of a two-phase circuit can be run off together, with the advantage of knowing that the conditions have not changed between readings.

Should thermo-voltages be produced their effect would be obviated by reversing the poles of the source of voltage. So far, however, this has made no difference.

If it be desired to know accurately the speed of the machine at the instant when the reading is being taken, one ring may be used with a cell of storage battery as a speed indicator, while the curve is being taken on the other ring, the connections being made as in the case of the speed indicator above. The reading may be standardized by taking a reading with a regular speed indicator for a minute and averaging up the readings on the electrical speed indicator, taken every two seconds during the same minute.

My thanks are due to my laboratory assistant, Mr. Kintner, who made the drawings for the instrument and worked out a number of the details. To Mr. Willyoung also I am indebted for the workmanlike manner in which his firm constructed the apparatus.

The Proposed Pacific Submarine Cable.

A dispatch from Honolulu, Hawaii, states that the Hawaiian Government has decided adversely on the request for an extension of the terms of the cable franchise granted by that Government to Col. Z. S. Spalding and by him subsequently transferred to the Pacific Cable Company of New Jersey. The new contract calls for the exclusive privilege to land cables in Hawaii, connecting with Japan and Australia, and also the extension of two years in which to obtain a subsidy of $160,000 a year from Japan and Australia. Mr. Spalding for the purpose of inducing favorable action agreed to take up $375,000 Hawaii 4 per cent. bonds of the proposed new issue for refunding the Government debt. Hon. John W. Foster, who represented the Cable Company, urged the acceptance of the terms, but was on Nov. 23 notified by the Hawaii Government authorities that the request could not be granted.

Electrical Freaks.

A story comes from Newark, N. J., to the effect that Louis H. Gamp, an electrician of the Newark Electric Light & Power Company, a few days ago touched with his arm a wire carrying a 6000-volt current, receiving a severe flesh burn. He was stiffened out but did not lose consciousness. On examination of his body it was found that a piece of metal which Gamp had in one of his trouser pockets had left a mark upon his flesh, and around the edge of the sole of one of his feet was a row of small burns corresponding to the nails in his shoes.

Insulated Wires and Cables, Their Construction and Design —Insulation; Its Efficiency and Defects.

BY J. DRAPER BISHOP.

(*Continued from page 659.*)

NOTE.—Since the previous installments of this article went to press, the writer has been informed that a rubber compound cable made for the Cataract Construction Company, having a conductor of 350,000 c. m. to carry a current at 25,000 volts with a thickness of insulation of only $\frac{3}{32}$ of an inch, had been tested by that company up to 40,000 volts without disruption. That so high a voltage could be carried by a rubber compound cable with an insulation so far below what would be considered as safe in Europe, and having a conductor surface of nearly 950 square feet, was to me a matter of serious doubt, but the manufacturers, The Safety Insulated Wire & Cable Company, of New York, courteously showed me a telegram with the above figures, received directly from the Cataract Construction Company, and I have therefore now no hesitation in giving publicity to this remarkable achievement. The cable was lead-sheathed and is shown in Fig. 6 below.

Armoring and Lead Sheathings.—Although the correct armoring of a cable is a very important point, it would be beyond the interest of these papers to do more than state the general principles which govern its design, ignorance of which is a great contributor to the "junk heap."

It is not generally well enough understood that armor on a cable is simply a protection or an attempt to protect the internal core from external accident, and has nothing whatever to do with the cable save as armor, or as a means of suspension. Cables are often laid across lakes and rivers with armoring sufficiently strong to protect the shore end of a cable on a rocky coast, when in reality the armor is utterly useless and more probably a means of destruction than of protection.

The writer has in mind one cable whose heavy armoring made it just the very means, in just the very place where heavy barges and fishing smacks found mooring for their buoys, with the result that the cable was damaged and out of working order more than half its time. It was at last replaced very quietly by a slight fragile cable equal to very little strain. This was broken within 24 hours, with the result that one boat drifted onto the rocks and remained there. The others took the lesson to heart and carefully avoided trying to moor there for the future, and the second slender cable was allowed to remain in working order for years without disturbance. This is but one case of course, but it exemplifies the fact that if there is nothing to fear armor is useless, so long as the cable core has tensile strength enough to safely bear its weight in water from boat to bottom.

It is better to make a long detour at an expense than to cross water-ways or anchorage grounds with a cable, no matter how heavily armored, for in a battle between the mariner and the submarine the cable will suffer every time.

If a cable has to be armored the number and size of the wires will have to be decided by the probable causes of damage—and also by the means of transport. For the shore end of a rocky sea beach, or crossing a rapid with rocky bed, the requisite strength of armor might only be obtained at such a sacrifice of flexibility that overland conveyance would be impossible.

As a general rule the size and consequently the number of wires for any particular cable will be determined by the wear or accident they have to resist, and the flexibility will be dependent on and proportionate to the sharpness of the lay. Armor wires should always be well bedded in jute, and where required for tensile strength rather than resistance to abrasion, small steel wires well wrapped with jute will be light and flexible. The armoring should not be laid on so scantily as to crush down on the cable nor so liberally as to be loose. In either case it will not support pressure, but will distort and fall in or bulge out, one or more wires perhaps over-riding.

FIG. 6.

A perfect armoring should be able to stand by itself like a flexible tube without support, either inside or out. In practice this is not always easy to attain, but the variation should rather be on the side of looseness than of a tight fit. In places where boring animals exist, the armor just spoken of is useless, and a brass or steel overlapping spiral tape is used, making a complete and continuous armor against all insect attacks.

The above armor is almost exclusively confined to marine or subaqueous use, but for the growing needs of underground work a special kind of armor is gradually forcing itself into notice. Over a soft bedding of jute is wound a soft steel ribbon or strip, of a width dependent on the "lay" or flexibility desired and thickness dependent on the protection required. There may be one, two, three or four strips wound on in opposite or reverse directions, and there is no difficulty in thus obtaining almost any degree of flexibility required. The spirals do not meet closely and if properly put on, slide very nicely over each other under flexure. The strips may range for large cables of say 2½ or 3 inches in diameter, from 3 inches to 1 inch in width and from .062 to .01 of an inch in thickness.

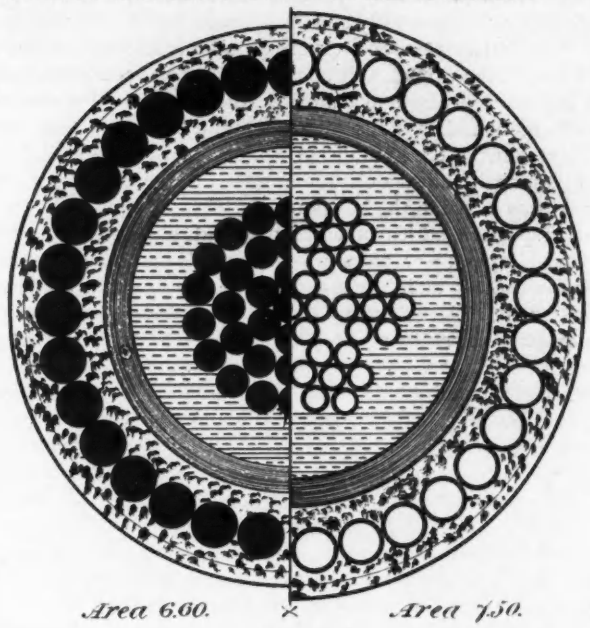


FIG. 7.

A curious illusion may strike the reader who is not *au fait* at cable work when examining this drawing. The armor plating looks as if it were bent into a cylindrical shape longitudinally while being applied. But this is only in appearance, not in fact. Really the armor remains perfectly flat, but the diagonal cross-section of the spiral ribbon is misleading to the eye. It will be easily seen that the point of a sharp rock, a crowbar, nail or other means of injury would glide harmlessly off this turtle back, while it would puncture, tear away or otherwise materially damage cable protected with the ordinary wire armor.

This armor is easy of application, cannot well break off or in any way damage the core and would resist without the least damage crushing strains which would be fatal to ordinary cable armor. It is therefore peculiarly adapted for use in towns and country roads or any places subject to disturbance. Like the tortoise it carries its own armor on its back, and therefore requires no expensive conduit in which to find protection, and will also enable electric conductors to be led over places and through grounds which would otherwise be often prohibitive if not impossible.

General Design of Cables.—It is easy to understand that with the impressions left on the technical as well as on the public mind, by the publication of details of wire rope or cable for ship use, bridge building, elevators, etc., an electrical cable may seem to be endowed with the same requirements as any other. This is an error which has often caused much unnecessary expense. It is true that in deep sea cables tensile strength and flexibility are the dominant factors of its armor design, protection from mechanical injury being left rather to care in handling than to the armor; not so for river and underground.

In mechanical applications for running purposes, the cable is supposed to be subjected to wear only. But in electrical light and power cable armoring the case is rather the reverse. The cable may have to withstand much heavy hauling and rough handling as well as liability to damage from blows and crushing strains, but so long as there is a fair margin of strength over and above that necessary for hauling in a comparatively short length, or burying a long one, tensile strength may be neglected, and as the cable once laid is not supposed to be again coiled or uncoiled, processes which should be carefully avoided whenever possible in all but special cables, its flexibility is not of such great importance. But with the very large conductors now often used it is not impossible that the mistake may be made of putting an expensive flexible armor on a very stiff conductor.

Generally it appears to the writer, who has had many years' experience in cable handling and design, that with a full cognizance of the conditions required to be met, the present design of cables is antiquated and crude. It would take too much space to treat this important subject as fully as it deserves, but as a generalization I embody in the accompanying sketches my own idea of what a cable should be compared with about what it is at present.

The right-hand section of a cable, Fig. 7, shows a way of making stranded conductors for large currents, which is unavoidable in small factories where the cabling facilities are limited. The core ismade up of seven or more strands, each of seven wires. It will be easily perceived that this method takes up more diametral space or area than either of the others, and consequently requires more insulation, more lead, more juting and armoring, and gives a correspondingly increased amount of inductive capacity and a diminished insulation test on account of the greater surface exposed. The other half section adjoining it shows a conductor of the same sectional area or circular mils as made in the best and leading factories.

The respective series of wires are laid on over each other in "reversed layers," or more properly, reversed "lays"—that is to say in alternately a right hand lay and left hand lay. These conductors are flexible and compact, and, as will be seen, offer less insulation and capacity surface than the first one. They require expensive machines. The writer lately designed and erected one for this work, capable of handling 130 reels of wire, each weighing over 1000 pounds, putting on six layers in reversed "lays" at one operation, and capable of making nearly one mile a day of 3,000,000 circular mils copper conductor.

Fig. 8 shows the cross section of a cable which for strength o armor and reduction of size to a minimum cannot be equaled.

In this design the conductor is made up of copper ribbons laid on spirally in the same manner as the steel armor spoken of above. Compared with the other two sections its diminished area speaks for itself. Here we have conductor surface reduced to the lowest possible amount, and consequently higher insulation test combined with lower inductive capacity.

It would be equally flexible with either of the other sections and weigh proportionately lighter, while from a constructive point of view it would be much more easily and quickly made and would require far less costly machinery.

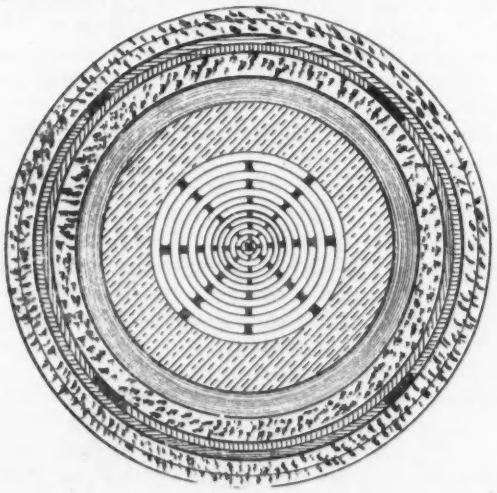


Fig. 8.

In all three sections the conductors are drawn to the same areas, the thickness of insulation lead and jute being of the same conventional thickness in each. Letters patent have been applied for on this method of making electrical conductors.

Fig. 9 shows a design for a concentric cable with both conductors composed of spiral ribbons of copper, insulated with paper and protected by a sheathing of rubber beneath the lead, the armoring being of steel in four thin plates.

Such a cable possesses the maximum of carrying power and safety, while occupying a minimum of space.

Lead Sheathing.—That the great degree of success attending underground cable work is due to lead sheathing is as unreliable as is the fact that like charity "it covereth a multitude of sins."

Although legitimately and of necessity used to protect the first-class insulation of first-class manufacturers from the all-destroying effect of mother earth, it has been and doubtless is the salvation of the credit of the shoddy manufacturer and the service life of his product, which depends entirely on the integrity of the lead sheathing to hide the slow deterioration slowly but surely fitting it for the junk heap. The virtues of lead may be summed up by saying that nothing yet has been found to supersede it, notwithstanding the fact that its great weight and cost have induced hundreds of inventors to spend time and money in vain endeavors to find a cheaper and lighter substitute.

The first application of lead pipe to perfect insulated conductors

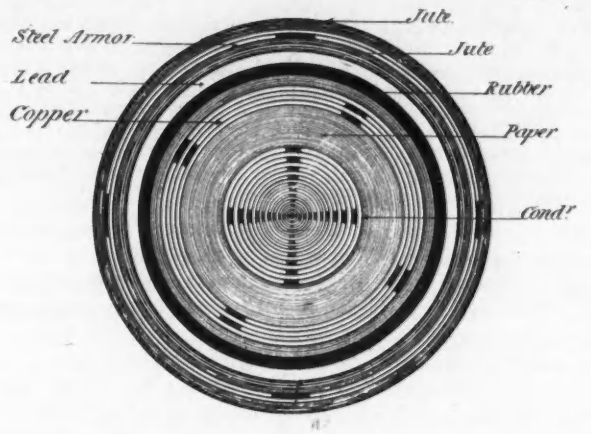


Fig. 9.

does not seem to be recorded, but it is certain that it originated in Europe and the author believes the credit due to Siemens & Halske of Berlin, who adapted it for the Government underground lines between that and other cities.

A great amount is used in the United States in the present day, some cable-makers using as much as 40 to 70 tons per week. In its application the practice in this country closely approaches that of England. In France and Germany, however, two or three thin coatings, with intervening thickness of fibre or other insulation are used, instead of one of greater thickness.

Wherein lies the benefit of several thin sheathings of lead instead of one stout one, is to me difficult to perceive.

It requires the repetition of a tedious and costly process, which undoubtedly increases the risk of rupture of the sheath, which increases in proportion to its thinness. Perhaps, too, on account of the prevalence of the use of gutta percha insulation, the common practice in Europe is to apply the lead cold, which requires enormous pressure, almost prohibiting the use of tin with the lead, exceedingly careful work, and great original outlay, while it can in no way be considered as a continuous process, for once the machine having exhausted its charge, there seems to be a necessity for taking it to pieces to renew the charge, while should it "stick," as accidental refusal to move is termed, there is nothing for it but to cut the cable, a risk which more than outweighs any other advantages.

Besides, it is not altogether a "cold" process, parts of the machine surrounding the dies being heated whenever and to whatever extent it is permissible to do so. Still, if gutta-percha insulation has to be covered with lead there seems to be no alternative, and as this kind of press will cover all other kinds of insulation as well, it has held its ground better in Europe than here, where it has been tried but, I am informed, abandoned. It is certain that the cold process is more expensive in its working and more difficult than the hot process about to be described, although it would certainly seem to possess one advantage, *viz.*, being a vertical machine in which the cable is passed up vertically through the charge of lead and out of the die, the pressure, great as it is, is distributed equally all around the core bar and die, so that a perfectly concentric sheath of uniform thickness is secured without much effort, an effect only obtained in the horizontal hot process in use with us by great care, skill and the knowledge of what may be termed the "personal equation" of not only every "block" but every die and nozzle therewith.

(*To be continued.*)

English Gas Companies in the Electric Light Business.

English gas companies have hitherto not taken kindly to the idea of undertaking electric lighting in connection with their gas business, but a change seems to have come over them in this regard. The Hoylake & West Kirby Gas & Water Company, together with the public of that district has, according to our English correspondent, petitioned the Court of Chancery to allow it to add electric lighting to its other business. The petition was granted on the understanding that the company shall suitably change its name.

Calculation of Electric Motors.

BY ALFRED E. WIENER.

While the subject of generator design has received abundant treatment in the technical press, that of motor calculation is very seldom approached from a practical standpoint.

It is a well-known fact that a properly designed generator will also be a good motor, and the general calculation of an electric motor therefore can be resolved into the calculation of a generator, provided the capacity of the latter is such that, when run as a motor, it gives the required power at the proper speed. Hence, the most practical way to proceed in a motor design is to first determine the output and the voltage this motor would produce when driven as a generator, at the given speed, and to then determine the dimensions and windings of that generator in the ordinary manner by employing the usual rules and formulæ. This being done, the calculation is completed by computing the speed attained at, and the current required for, various loads.

I. Capacity of Generator Corresponding to a Motor of a Given Output.—Considering a given dynamo as a generator, its output, P_1, in watts at the terminals is the total energy, P', generated in its armature by electromagnetic induction due to the relative motion between the conductors and the magnetic field, diminished by the amount of energy absorbed between the armature conductors and the machine terminals; that is, by the loss due to internal electrical resistances. In other words, the output is the total electrical energy produced in the armature multiplied by the electrical efficiency of the dynamo. The output, P_2'', of the same machine when run with the same speed as a motor is the useful electrical energy, P', active within its armature in setting up electromagnetic induction, less the energy lost between armature and pulley; that is, less the loss caused by hysteresis, eddy currents and friction, or is the product of electrical activity and gross efficiency. Conversely, the power, P_1'', to be supplied to the generator pulley must be the total energy, P', produced in the armature, increased by an amount equal to the magnetic and frictional losses, or must be P' divided by the gross efficiency. And the energy, P_2, finally, required at the motor terminals in order to set up in the armature an electrical activity of P' watts is found by adding to P' the energy needed to overcome the internal resistances of the motor, or by dividing P' by the electrical efficiency. Designating the electrical efficiency of the machine, *i. e.*, the ratio of its useful to the total electrical energy in its armature, by η_e, and its gross efficiency, or efficiency of conversion, *i. e.*, the ratio between the electrical activity in the armature and the mechanical power at the pulley, by η_g, we therefore have

Output of machine as generator:

$$P_1 = \eta_e \times P' ; \qquad (1)$$

Output of machine as motor:

$$P_2'' = \eta_g \times P' ; \qquad (2)$$

Power to be supplied to machine when run as generator (driving power):

$$P_1'' = \frac{P'}{\eta_g} ; \qquad (3)$$

Energy to be supplied to machine when run as motor (intake of motor:

$$P_2 = \frac{P'}{\eta_e} ; \qquad (4)$$

Where P_1, P_2 = electrical energy at terminals of machine, as generator and motor, respectively;

P' = electrical energy active in armature conductors, being the same in both cases;

P_1'', P_2'' = mechanical energy at dynamo pulley, for generator and motor, respectively.

By transposition of (2) the electrical capacity of the machine can be expressed by the motor output, thus:

$$P' = \frac{P_2''}{\eta_g},$$

which is to say that, in order to find the dimensions and windings for a motor of $hp = \frac{P_2''}{746}$ horse-power, it is necessary to figure a generator which at the given speed has a total capacity of

$$P' = \frac{P_2''}{\eta_g} = \frac{746 \times hp}{\eta} \text{ watts.} \qquad (5)$$

The E. M. F. for which this generator is to be calculated, or the counter E. M. F. of the motor, is the voltage at the motor terminals diminished by the drop of potential within the machine, or:

$$E' = E - I \times (r + r_{se}), \qquad (6)$$

in which

E' = E. M. F. active in armature, in volts;
E = voltage supplied to motor terminals;
I = current intensity at motor terminals;
r_a = armature resistance, at working temperature, in ohms;
r_{se} = resistance of series field, warm, in ohms, for series and compound machines; in case of shunt dynamo $r_{se} = o$.

Formula (6), though theoretically accurate, is not practically so, since for the same excitation, armature current and speed, the counter E. M. F. of a motor is greater than the E. M. F. when used as a generator for the following reasons: In the generator the proper position of the brushes is determined by the sum of the influence of armature reaction and of self-induction, while in a motor it depends on their difference; in a motor, therefore, the shifting of the brushes is less than that in a generator by double the effect of the self-induction; as the weakening of the field by the armature increases proportional to the angle of lead (or lag), it follows that in a generator the armature current weakens the field more than in a motor. The magnetic field due to the eddy currents is less in the generator than in the motor on account of the diminished waste field and has the opposite effect upon the useful field. The eddy currents in the generator weaken the field, while in the motor they strengthen it; finally, in the generator the self-induction diminishes the E. M. F., while in a motor it strengthens the counter E. M. F. For the purpose at hand, however, formula (6) gives the required counter E. M. F. with sufficient accuracy, particularly because neither the current strength nor the resistances usually being prescribed, the drop must be estimated. The latter is best done by means of the following Table I, which gives the average percentage of drop in shunt, series and compound dynamos of various capacities:

TABLE I.—DROP OF E. M. F. DUE TO INTERNAL RESISTANCES.

Capacity in Kilowatts.	Drop of Potential in Per Cent. of Output E. M. F.					
	Shunt Dynamos.		Series Dynamos.		Compound Dynamos.	
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Up to .5	20	to 12	40	to 25	30	to 20
" " 1	12	" 10	25	" 20	20	" 15
" " 2.5	10	" 8	20	" 16	15	" 12
" " 5	8	" 7	16	" 14	12	" 10
" " 10	7	" 6	14	" 12	10	" 8
" " 25	6	" 5	12	" 10	8	" 7
" " 50	5	" 4	10	" 8	7	" 6
" " 100	4	" 3½	8	" 6	6	" 5
" " 200	3½	" 3	6	" 5	5	" 4
" " 500	3	" 2½	5	" 4	4	" 3
" " 1000	2½	" 2	4	" 3	3	" 2½
" " 2000	2	" 1½	3	" 2½	2½	" 2

By dividing the electrical activity, P', as obtained from formula (5), by the E. M. F. E', the current capacity of the corresponding generator is found:

$$I' = \frac{P'}{E'} \qquad (7)$$

For the purpose of simplifying this conversion of a motor into a generator of equal electrical activity, the accompanying Table II is given which contains the average efficiencies, and the active energy for motors of various sizes:

TABLE II.—AVERAGE EFFICIENCIES AND ELECTRICAL ACTIVITY FOR ELECTRIC MOTORS OF VARIOUS SIZES.

Output of Motor, hp, in Horse-power.	Electrical Efficiency, η_e.	Gross Efficiency, η_g.	Commercial Efficiency, $\eta_e = \eta_e \times \eta_g$.	Electrical Activity in Armature, $P' = \frac{.746 \times hp}{\eta_g}$, in Kilowatts.
½	.75	.80	.60	.5
1	.82	.82	.67	.9
2	.85	.84	.72	1.8
5	.87	.86	.75	4.0
10	.89	.88	.78	8.5
15	.90	.89	.80	12.6
20	.91	.90	.82	16.6
25	.92	.91	.84	20.5
30	.93	.92	.86	24.5
40	.94	.93	.87	32
50	.945	.935	.88	40
75	.95	.94	.89	60
100	.955	.9425	.90	80
150	.96	.945	.91	118
200	.97	.9475	.92	158
300	.98	.95	.93	236
400	.9825	.9525	.935	318
500	.985	.955	.94	391
750	.9875	.9575	.945	585
1000	.99	.96	.95	777

As an illustration of the use of the above formulæ and tables, let us take a dynamo capable of developing a total electrical activity of $P' = 10{,}000$ watts, and having an electrical efficiency of $\eta_e = .9$, or 90 per cent., and a gross efficiency of $\eta = .88$, or 88 per cent. Then, by (1), its output as a generator :

$$P_1 = .9 \times 10{,}000 = 9000 \text{ watts ;}$$

and by (2) its power as a motor :

$$P_2'' = .88 \times 10{,}000 = 8800 \text{ watts} = 11.8 \text{ horse-power.}$$

The driving power required at the pulley when run as a generator, is by (3) :

$$P_1'' = \frac{10{,}000}{.88} = 11{,}364 \text{ watts} = 15.25 \text{ horse-power,}$$

and the intake to be supplied to its terminals when run as a motor. by (4) :

$$P_2 = \frac{10{,}000}{.9} = 11{,}111 \text{ watts.}$$

If the output as a motor, $P_2'' = 11.8$ horse-power, is given, and the problem is to find the electrical activity in the armature of the corresponding generator, formula (5) is employed, and we obtain :

$$P' = \frac{746 \times 11.8}{.88} = 10{,}000 \text{ watts.}$$

The same result could have been received from the preceding Table II., by taking the value of η_g for the nearest horse-power, provided the efficiency of the motor is not otherwise given.

Supposing the above motor is to be series wound, and to be run from 200-volt mains, Table I. gives an average drop of from 14 to 12 per cent. Taking the lower limit we obtain a drop of $.12 \times 200 = 24$ volts, or, by (6), the E. M. F. active in the armature of the corresponding generator :

$$E' = 200 - 24 = 176 \text{ volts.}$$

Formula (7) finally gives the current capacity of the generator having equal electrical activity with the given motor, as:

$$I' = \frac{10{,}000}{176} = 57 \text{ amperes.}$$

II. Speed Calculation of Electric Motors.—If a generator which at a speed of N_1 revolutions per minute produces a total E. M. F. of

$$E_1' = E + I' \times (r_a + r_e) \text{ volts,}$$

is run as a motor having same current strength in armature, the motor armature, in order that no more nor less than this current, I' its full load a sa generator, shall flow, must generate a counter E. M. F. of

$$E_2' = E - I' \times (r_a + r_e) \text{ volts.}$$

The speed necessary to generate this back voltage, speed being proportional to voltage, is:

$$N_2 = \frac{E_2'}{E_1'} \times N_1 = \frac{E - I' \times (r_a + r_{se})}{E + I' \times (r_a + r_{se})} \times N_1, \qquad (8)$$

which is the speed of the motor at full load, provided the E. M. F., E, supplied to its terminals is equal to the voltage when run as generator.

The speed of the motor for any given E. M. F. applied to its armature terminals depends (1) upon the load impressed upon the motor armature, or the torque τ, it has to exert; (2) on the electrical resistance, $(r_a + r_{se})$, of the armature and the series field; and (3) upon its specific generating power, or its capability of producing counter E. M. F., *i. e.*, the number of volts, e, it produces at a speed of one revolution per second.

The specific generating power of the motor being

$$e = \Phi \times \frac{N_c}{n_p} \times 10^{-8} \text{ volts at 1 rev. p. sec.,} \qquad (9)$$

where Φ = useful flux, in webers ;

N_c = number of conductors on armature ;

n_p = number of pairs of armature circuits electrically in parallel,

the total counter E. M. F., at the required speed of N_2 revolutions per minute, will be

$$E'_2 = e \times \frac{N_2}{60} = \frac{\Phi \times N_c \times N_2}{60 \times 10^8 \times n_p},$$

and the current flowing in the armature, therefore, is :

$$I' = \frac{E - E_2}{r_a + r_s} = \frac{E - e \times \frac{N_2}{60}}{r + r_{se}}. \qquad (10)$$

The activity of this current expended upon the counter E. M. F. will be their product, $E'_2 \times I'$ watts, and this must be equal to the total rate of working, which is the product of circumferential speed and turning moment, or torque; that is, it must be equal to

$2\pi \times N_2 \times \tau \times \frac{746}{33{,}000}$ watts, where the torque, τ, is calculated from : *

$$\tau = \frac{11.74}{10^{10}} \times I' \times \frac{N_c}{n_p} \times \Phi \text{ foot pounds ;} \qquad (11)$$

hence we have :

$$\left(e \times \frac{N_2}{60}\right) \times \frac{E - e \times \frac{N_2}{60}}{r_a + r_{se}} = 2\pi \times \frac{N_2}{60} \times \tau \times \frac{746}{550}$$

from which

$$N_2 = 60 \times \left(\frac{E}{e} - 8.52 \times \frac{(r_a + r_{se}) \times \tau}{e^2}\right) \qquad (12)$$

From (12) follows that, if either the internal resistance or the torque is zero, since the second term in the parenthesis then disappears, the speed of the motor is

$$N_2 = 60 \times \frac{E}{e} = \frac{60 \times E \times n_p \times 10^8}{\phi \times N_c} \qquad (13)$$

This reduced formula (13) indeed holds very nearly in practice for very large motors (in which the internal resistance is very small) and also is approximately followed in case of motors running free (the torque then being only that necessary to overcome the frictions).

Numerical Example Showing Application of Formulæ (8) to (11).—A shunt dynamo generates an output E. M. F. of $E = 250$ volts when driven at a speed of $N_1 = 1500$ rev. per min.; the drop in its armature at full load is $I' \times r_a = 15$ volts; to find the speed it will run at as a motor under full load, (1) when supplied with 250 volts, (2) when supplied with any other line potential, say 200 volts.

The first part of this problem is directly solved by means of formula (8), from which

$$N_2 = \frac{250 - 15}{250 + 15} \times 1500 = 1330 \text{ revs. per min.}$$

The speed of the motor for the second voltage, since the behavior of the machine as a generator is known, can be similarly obtained thus :

$$N_2 = \frac{200 - 15}{250 + 15} \times 1500 = 1045 \text{ revolutions per minute.}$$

If, however, the speed as a generator is not known, the second part of the problem is solved by the use of formulæ (9) to (13), as follows: Assuming that in figuring this motor we have found $\Phi = 4{,}000{,}000$ webers, $N_c = 264$ conductors, $n_p =$ one pair of parallel armature circuits, and $r_a = .08$ ohm, its specific generating power is obtained, by (9) :

$e = 4{,}000{,}000 \times 264 \times 10^{-8} = 10.6$ volts at one revolution per second, its current capacity, by (10) :

$$I' = \frac{15}{.08} = 187.5 \text{ amperes,}$$

and its torque, by (11) :

$$\tau = \frac{11.74}{10^{10}} \times 187.5 \times 264 \times 4{,}000{,}000 = 233 \text{ foot-pounds.}$$

Hence, by (12), its speed for a supply of 200 volts :

$$N_2 = 60 \times \left(\frac{200}{10.6} - 8.52 \times \frac{.08 \times 233}{10.6^2}\right) = 1045 \text{ revolutions per min.}$$

Supposing the energy required at no load is $P_o'' = 4000$ watts, the current intensity for 200 volts is

$$I_o' = \frac{P_o''}{E} = \frac{4000}{200} = 20 \text{ amperes,}$$

and therefore the torque

$$\tau_o = \frac{11.74}{10^{10}} \times 20 \times 264 \times 4{,}000{,}000 = 25 \text{ foot-pounds.}$$

This into (12) furnishes the speed at no load :

$$N_2 = 60 \times \left(\frac{200}{10.6} - 8.52 \times \frac{.08 \times 25}{10.6^2}\right) = 1121 \text{ revs. p. min.,}$$

while by the approximate formula (13) we obtain :

$$N_2 = 60 \times \frac{200}{10.6} = 1130 \text{ revs. p. min.,}$$

which is less than 1 per cent. greater than the accurate value.

(To be continued.)

* See "Practical Notes on Dynamo Calculation," by A. E. Wiener, Section 22; THE ELECTRICAL WORLD, Vol. XXIV, p. 57 (July 21, 1894).

Some Recent Developments in Magnetic Testing.*

BY J. A. EWING.

For some time back the writer has used a special procedure in the ballistic test of bars, which, although it was mentioned in his paper "Magnetic Testing," read in May last at the Institution of Civil Engineers, may still be new to most readers.

The object of the novel process is to eliminate the error due to the magnetic resistance of the yoke in tests made with bars and yokes. When a bar is magnetized in a yoke the ampere-turns acting on the bar do not all go to overcome the magnetic resistance of the bar itself. Part of them go to overcome the resistance which the induction meets with in passing out of the bar into the yoke, and also the resistance within the yoke itself. It has been customary to neglect

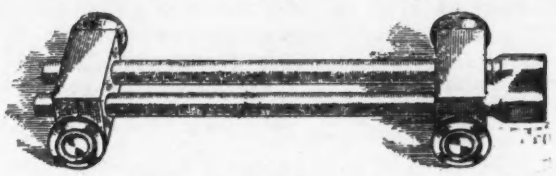


FIG. 1.

this, treating it as a negligibly small quantity, and to take the value of the magnetizing force $\mathfrak{H}$ acting on the bar as simply equal to

$$\frac{0.4\pi CN}{L},$$

where L is the clear length of the bar measured from the place where it leaves the yoke at one end to the place where it reaches the yok at the other, C is the current in amperes, and N the number of turns in the magnetizing coil. But in strictness, and especially when we are dealing with the very permeable iron or steel now obtainable for dynamos, the correction which should be made for the resistance of the yoke and the joints and the sunk ends of the bar is by no means negligible.

The actual state of affairs may be written

$$0.4\,\pi\,C\,N = \mathfrak{H}\,L + \varepsilon,$$

where ε represents that part of the M. M. F which is used up in overcoming the resistance of the yoke, the joints, and the sunk ends of the bar. The following procedure allows us to find ε and so determine the true value of $\mathfrak{H}$.

For this purpose two equal bars are used, with two short yokes joining their ends, as in the figure (Fig. 1). The yokes are bored so that the bars are an easy fit in them, and set screws at each end pressing against the outside surface of the bars serve to make a satisfactory magnetic joint. For convenience of calculation the clear length between the yokes is made equal to $4\,\pi$ or 12.56 centimetres, and on each bar there is a magnetizing coil of 100 turns.

If we call $\mathfrak{H}'$ the *apparent* magnetizing force acting on the bars—or, in other words, the force uncorrected for ε—and L_1 the clear length between the yokes, we have

$$\mathfrak{H}' = \frac{0.4\pi CN}{L_1},$$

which in this case becomes

$$\mathfrak{H}' = 10\,C.$$

That is to say, each ampere produces 10 C. G. S. units of apparent magnetizing force.

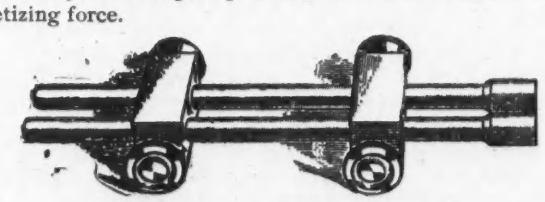


FIG. 2.

After a test has been made in this way and the relation of $\mathfrak{B}$ to the uncorrected force $\mathfrak{H}'$ has been determined, the yokes are pushed up closer as in Fig. 2, so that the clear length of each bar is now only half what it was before, or 6.28 cm. Magnetizing coils of 50 turns each are now used. Let $\mathfrak{H}''$ be the apparent force now acting, or

$$\mathfrak{H}'' = \frac{0.4\pi CN_2}{L_2};$$

then each ampere of current still produces an apparent force $\mathfrak{H}''$ of 10 C. G. S. units. A second test is made with this reduced length of the bars to find the relation of $\mathfrak{B}$ to $\mathfrak{H}''$.

From these two tests we have the data for eliminating ε and finding the true $\mathfrak{H}$. At any one induction the true force $\mathfrak{H}$ must be the same in both cases (if the bars are of uniform quality), and the correction ε for the yokes and joints is also the same in both cases. Thus,

$$\mathfrak{H} = \mathfrak{H}' - \frac{\varepsilon}{L_1};$$

and

$$\mathfrak{H} = \mathfrak{H}'' - \frac{\varepsilon}{L_2};$$

from which

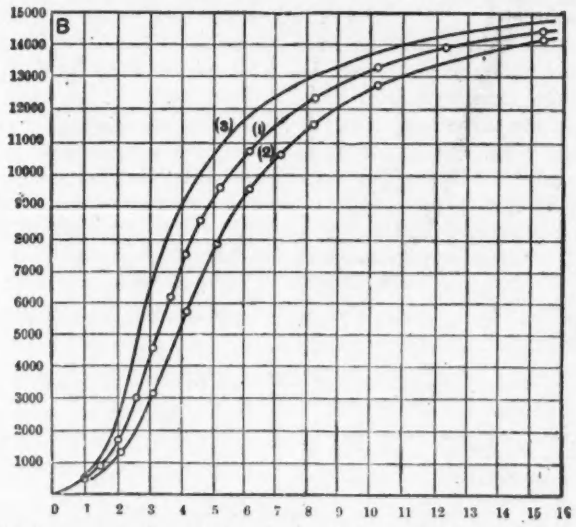
$$\mathfrak{H}'' - \mathfrak{H}' = \frac{\varepsilon}{L_2} - \frac{\varepsilon}{L_1}.$$

But L_2 was taken equal to $\frac{1}{2}\,L_1$, hence

$$\frac{\varepsilon}{L_1} = \mathfrak{H}'' - \mathfrak{H}'.$$

In order, then, to find $\mathfrak{H}$ we have only to subtract from $\mathfrak{H}'$ the amount $\mathfrak{H}'' - \mathfrak{H}'$, which is directly determined by comparing the result of the two experiments.

Once this correction is made, the method of the yoke is as rigorously accurate as could be wished. And practically it offers several advantages as compared with the use of a ring. A straight bar is easier to shape than a ring. It can have its area of section more truly determined. The test can be made with a smaller specimen, and the magnetizing coils are a permanent part of the appara-



$\mathfrak{H}$ for curve (3), $\mathfrak{H}'$ for curve (1), $\mathfrak{H}''$ for curve (2).

FIG. 3.—METHOD OF CORRECTING FOR YOKES.

tus, and do not have to be wound separately for every sample in the laborious way that is unavoidable in testing rings.

An example will help to make the method clear. The following figures relate to a pair of Lowmoor bars tested in this way. The bars were turned to a diameter of ⅜ inch or 0.952 centimetre. The yokes were rectangular iron blocks, with a cross-section of 2.0 centimetres by 2.5 centimetres, and the distance between the centre lines of the two bars was 2.2 centimetres.

Ballistic observations were made, first with the full clear length of 12.56 centimetres, and then with half that length. The following table gives a selection of the observed points, from which the curves marked 1 and 2 in Fig. 3 have been drawn.

I.—Bars 12.56 cm long between the yokes.		II.—Bars 6.28 cm long between the yokes.	
$\mathfrak{H}'$.	$\mathfrak{B}$.	$\mathfrak{H}''$.	$\mathfrak{B}$.
2.05	1,650	2.05	1,360
3.07	4,600	3.07	3,160
4.10	7,440	4.10	5,660
5.12	9,460	5.12	7,920
6.15	10,750	6.15	9,560
8.20	12,280	8.20	11,590
10.25	13,200	10.25	12,700
15.4	14,410	15.4	14,160
20.0	14,950	20.0	14,750
30.0	15,700	30.0	15,550
50.0	16,550	50.0	16,470
70.0	17,150	70.0	17,050
120.0	18,100	120.0	17,960

* From advance proof sheets of London *Electrician*.

The curves as reproduced here show only the parts of the tests dealing with forces up to 20 C. G. S. units. The abscissæ are $\mathfrak{H}'$ in curve (1) and $\mathfrak{H}''$ in curve (2).

The curve (3) of the same figure is drawn from the other two, by taking as abscissæ

$$\mathfrak{H} = \mathfrak{H}' - K$$

for each value of , where K is $\mathfrak{H}'' - \mathfrak{H}'$. This is the true curve of $\mathfrak{H}$ and $\mathfrak{B}$ for the material.

It will be noticed that the correction K for the yokes, which is shown by the horizontal distance between curve (3) and curve (1), is by no means an insignificantly small quantity, even with short yokes such as were used here. When the ordinary form of yoke is used the proper correction will be still greater, and to omit it involves a somewhat serious error. Its effect is to make the apparent permeability too low, especially in the steep part of the curve, and also to make this residual magnetism considerably too low, when the test piece is put through a cyclic process.

In developing this new method, which makes the proper correction for the yoke possible and easy, the author's main object was to obtain accurate tests of the primary standard bars to be used with his new permeability bridge. The test which has just been quoted was one of the several made for this purpose. Once a standard bar has had its true $\mathfrak{B}$-$\mathfrak{H}$ curve determined in this way, the permeability bridge allows other bars to be readily compared with it, and to have their curves drawn without the need of further ballistic tests. Indeed, the bridge may be used with advantage to compare against one another the two bars which are used in the primary ballistic test itself, as described above, so that any difference which may be found between them may be allowed for in the final estimate of the results for either bar. When the two bars are turned from adjoining portions of the same rod, and are similarly treated in every way, no great difference is found; but the permeability bridge is well adapted to show even very small differences.

When the correction K is known for any particular pair of yokes and bars we are in a position to estimate what magnetizing current is needed to reach any desired value of the induction $\mathfrak{B}$. To reach any value of $\mathfrak{B}$ it is necessary to use a current which will produce an apparent magnetizing force equal to $\mathfrak{H} + K$. If the apparent force (or $\mathfrak{H}'$) is 10 per ampere, as it was in the instance quoted, and as it is in the ordinary construction of the permeability bridge, the proper current in amperes is not $\frac{\mathfrak{H}}{10}$, but $\frac{\mathfrak{H} + K}{10}$. Applying this to the example already quoted we have, by measurement from the curves of Fig. 3:

$\mathfrak{B}$	$\mathfrak{H}$	Proper current in amperes.
2,000	1.90	0.22
4,000	2.39	0.29
6,000	2.86	0.35
8,000	3.53	0.44
10,000	4.50	0.55
11,000	5.30	0.64
12,000	6.45	0.76
13,000	8.1	0.96
14,000	10.8	1.27
15,000	17.3	1.98
16,000	31.2	3.48
17,000	59 0	6 35
17,500	80.0	8 5
18,000	110	11.5

Thus, in using the permeability bridge with the same or similar yokes, and with this bar as standard, to test another bar which is not excessively different in its magnetic quality, if we wish to make the comparison of magnetizing force at, say, an induction of 10,000, we should apply a current of 0.55 ampere. Then when balance is obtained the ratio shown by the bridge will be, with all necessary exactness, the ratio between the two magnetizing forces required by the standard bar and by the test bar, respectively, to produce in each of them an induction of 10,000.

As an example of the use of the permeability bridge in this way the following test may be cited: It refers to a bar turned from an unforged dynamo steel casting. The standard bar used was the one the curve of which is drawn in Fig. 3. To compare $\mathfrak{H}$ for the test bar with $\mathfrak{H}$ for the standard bar a current of 0.22 ampere was applied, thereby producing an induction of 2,000. A balance was obtained with 87 on the dials; that is to say, 87 turns on the test bar balanced 100 on the standard bar. Hence $\mathfrak{H}$ on the test bar for $\mathfrak{B} = 2{,}000$ is $\frac{1.90 \times 87}{100}$, or 1.65.

Next for $\mathfrak{B}$=4,000, a current of 0.29 ampere was applied, and a balance was obtained with 92 on the dials, making $\mathfrak{H}$ on the test bar= $\frac{2.39 \times 92}{100}$, or 2.20. The same procedure was continued with currents of 0.35, 0.44, etc., with the following results:

$\mathfrak{B}$	Current Applied.	$\mathfrak{H}$ on standard bar.	Reading on dial.	$\mathfrak{H}$ on test bar.
2,000	0.22	1.90	87	1.65
4,000	0.29	2.39	92	2.20
6,000	0.35	2.86	101	2.89
8,000	0.44	3.53	115	4.06
10,000	0.55	4.50	127	5.70
12,000	0.76	6.4	135	8.67
13,000	0.96	8.1	136	11.
14,000	1 27	10.8	134	14.5
15,000	1.98	17.3	126	21.8
16,000	3 48	31 2	114	35.6
17,000	6.35	59	107	63
17,500	8.5	80	104	83

The test is illustrated in Fig. 4, which shows by the full line the $\mathfrak{B}$-$\mathfrak{H}$ curve of the standard, and by the dotted line the $\mathfrak{B}$-$\mathfrak{H}$ curve of the test piece as thus determined.

An important practical point in the use of the permeability bridge is this, that no great precision has to be aimed at in the adjustment of the current. So long as it is anywhere near the intended value, the reading, as shown by the dial, does not change, or changes very slightly. This is because the $\mathfrak{B}$-$\mathfrak{H}$ curves of the test piece and the

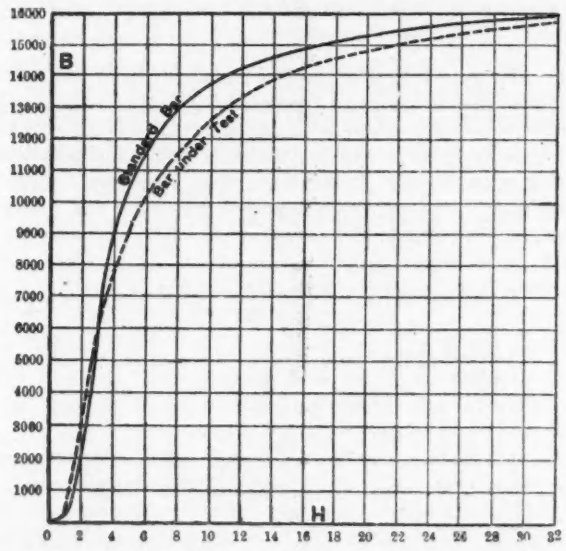


Fig. 4.—Method of Comparing Magnetizing Power Required in Different Bars to Bring Them Up to the Same Induction.

standard bar, even when they cross as in this example, follow the same general trend sufficiently to make the ratio of the forces alter but slowly when the force itself is increased or diminished. Hence, although in the above table the proper currents are stated to two places of decimals, a much rougher adjustment of them will serve in practice without impairing the accuracy of the results, and for their measurement any decent form of commercial amperemeter will suffice.

It must not be supposed, however, that measurements of magnetic quality made by the permeability bridge are themselves rough. On the contrary, the author knows no more delicate means of detecting and measuring small differences between one specimen and another. The absolute accuracy of measurements made with the bridge depends on the accuracy of the primary ballistic test of the standard bar; and if that is made by the method described in this paper it can claim an accuracy equal to that reached in any ballistic tests.

Electric Railways in Great Britain.

According to tabulated statistics in the November number of the *Railway World*, London, there are in Great Britain 24 electric tramways and railways in operation and under construction at the present time. The aggregate length of these lines is 106 miles, the longest single road being 8 miles and the shortest ¼ of a mile. There is a great variety of gauges, the narrowest being 3 feet, and the widest 18 feet. The latter gauge is an extraordinary one, and is that of the Seashore railway, running between Brighton and Rottingdean. Of the 24 lines 13 are operated on the overhead trolley system, 9 on the third rail system, one accumulator and one underground conduit. The aggregate horse-power of these lines is 9629.

Regulations in Japan.

To the Editor of The Electrical World:

SIR:—The construction placed upon our new regulations in a recent number of your journal is unjust, though it is the English translator who is culpable.

For example, the first item that you quoted is a mistranslation of the following; "50,000 watts with aerial line, and 200,000 watts in all other cases, are the maximum amounts permitted to be transmitted per wire, unless specially sanctioned."

Though some of the items are thought to be open to criticism, yet I may say our regulations, as well as our engineering knowledge, seemst c be under unjust opinion. H. H.

TOKYO, JAPAN.

Examination of Cathode and Röntgen Rays Through Colored Screens by Means of the Fluoroscope.

To the Editor of The Electrical World:

SIR:—The cathode rays in an excited Crookes tube, viewed through a pale-yellow screen, show increased brightness of the yellow rays.

Viewed through a dark-violet screen, the cathode rays present a phosphorescent glow, similar to that in a low-voltage lamp when held in the field of an induction coil.

Viewed through a green screen the cathode rays present to the eye a light emerald green.

Viewed through a dark red screen the cathode rays present a pale red on the carmine tint.

The screens are of thin polished glass plate, 1.5 mm thick, coated with gelatine, colored with aniline dyes such as I use in making my photochromic screens.

Examination of Röntgen rays through plain glass and the aforementioned screen, shows that both absorb or prevent fully 50 per cent. of the Röntgen rays from reaching the screen of the fluoroscope. Screens of the following colors were placed side by side with the clear glass, *viz.*: dark violet, green, light yellow and dark red, and when in juxtaposition, it was impossible to recognize which was clear glass and which was colored. The eye was unable to detect any color sensation when looking through the fluoroscope with the colored screens in close contact.

These experiments confirm me in the opinion which I have held since first dealing with the Röntgen rays, that they are of the ultra ultra-violet, because I find they absorb the entire spectrum, while a deep violet screen absorbs all but the red.

It was early determined by Prof. Röntgen that the rays which he discovered could neither be deflected nor refracted, and I am not aware of any experiments having been made to determine the absorptive powers by Röntgen rays of the colors of the spectrum.

JOHN CARBUTT.

PHILADELPHIA, PA.

The Heilmann Locomotive.

To the Editor of The Electrical World:

SIR:—Mr. Sam. H. Libby, in his letter to you, published in your issue of Nov. 28, attempts to prove the inferiority of the Heilmann locomotive, but I consider that he has made the strongest argument yet presented in favor of the Heilmann locomotive.

He apparently admits that, based upon the figures of tests thus far made, the Heilmann locomotive has a higher value, considering merely the saving in fuel, of $7450 over one of the best steam locomotives thus far made—namely, the one drawing the Empire State Express, but concludes from this showing that there is no chance for the Heilmann locomotive because it cannot to-day be purchased for $19,450.

When we remember that the figures for coal consumption upon which he bases his conclusion are in the case of the Heilmann locomotive those realized in the very first machine of its type ever made, while the figures of the steam locomotive refer to a machine which has been perfected to the very highest degree, by the most competent engineers of the world, with the data obtained from the building and operating of thousands and thousands of locomotives, I do not think that any fair-minded reader can doubt that the possibilities of marked improvement lie altogether on the side of the Heilmann locomotive.

It seems entirely likely that the Heilmann locomotives soon to be tested will show a marked improvement in coal consumption over the first one, for the test of the first one gave to the designers the first reliable data enabling them to design the locomotive with precision.

But the economy in coal consumption of the Heilmann is, to my mind, its least advantage. Its possible value will not be judged on any such basis unless the difference between its economy and that of the steam locomotive is remarkable one way or the other. Its possibilities lie in its enormous hauling power and its expected higher speed with safe results.

If the Heilmann locomotive will take a train to Chicago in two thirds of the present best time, and if it will haul double the weight at present possible by using one locomotive it will compete with the present steam locomotives with the same advantage for it that the *Campania* and *Lucania* possess over their slower but cheaper and more economical rivals, and with the same advantage that the heavy freight locomotives of to-day have over the lighter locomotives of less hauling power, which have almost disappeared from use during the past few years.

When all the leading railways find themselves warranted in laying heavier and heavier rails and rebuilding their bridges, and reducing their grades at the enormous expense which such work represents, and all for the purpose of increasing the speed and hauling power of their locomotives, it seems evident that conspicuous advantages as to speed and hauling power must necessarily be recognized in the course of time.

Mr. Libby seems to assume that it is readily possible to make a steam locomotive so as to secure perfect combustion of the coal for tunnel service while it is exerting its full hauling power. This is not true, which is evident when we realize that the Baltimore & Ohio Railroad has an electric locomotive plant at Baltimore costing over $500,000, which was installed to obviate this smoke nuisance of the steam locomotive.

In the case of the Heilmann locomotive for such service we can operate a boiler and engine under the most favorable conditions for perfect combustion; that is, ample boiler capacity and grate area, an engine running at a practically constant speed and cut off, and an electric reducing gear to enable us to secure any desired speed, and necessary drawbar pull to meet the changing conditions of practical operation. H. WARD LEONARD.

HOBOKEN, N. J.

Motor Cars on the Bridge.

An attempt was made on Sunday night last to run trains across the Brooklyn Bridge by means of the electric motor cars alone, but it seems to have been a failure. The conditions for such a test were extremely unfavorable. The tracks were slippery after the wet weather, and the third rail, from which current is taken, was in the worst possible condition, being covered with snow and ice. The result was, that when the contact shoe was put into operation there was a very fine pyrotechnical display, and much of the power was thus expended instead of going into the motors. One train got to the crest of the grade by a little aid from the cable, and finished its trip by the gravity alone, but the return journey was not so successful. The motor pulled the train a few rods and then became stalled. It was run back to the station and the cable was again called into service. Any system to be successful on the Bridge must manifestly be able to operate under the most unfavorable conditions. While the climatic conditions were unfavorable for the initial test of the electric system, the apparatus itself was not in normal condition, therefore the failure cannot be ascribed to the system, about the ultimate success of which there is hardly any doubt.

Later experience in the operation of the motor cars was, however, decidedly more successful. On Monday 12cars were put into service, and barring a few slight mishaps, the electric system of propulsion proved to be a great success. The motor cars were abundantly able to propel the trains over the Bridge without any trouble whatever, and Monday's experience demonstrated the entire practicability of the system. The mishaps referred to were due to the newness of the system and lack of familiarity in its operation.

Death of William Steinway.

Mr. William Steinway, one of the New York Rapid Transit Commissioners, and well-known throughout the country through his connection with the piano bearing his name, died at his home in New York City on the afternoon of Nov. 30. Mr. Steinway had been ill with tyhoid fever for three weeks, and was progressing toward recovery until Sunday when a relapse occurred. He sank steadily until the time of his death. Deceased was born in Seesen, Duchy of Brunswick, on March 5, 1836.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

DYNAMOS, MOTORS AND TRANSFORMERS.

Non-Synchronous Motors and Wave Forms. ROESSLER. *Elek. Zeit.*, Nov. 12.—The first part of an article on the action of non-synchronous motors when supplied with currents of different wave forms; he gives the results of measurements made with a motor, first when its current was obtained from a Ganz alternator, whose curve advances very rapidly to a sharply defined point, then falls equally rapidly and has a very low value during the rest of the phase; secondly, with a Siemens machine, which gave a nearly exactly sinusoidal curve; the same instruments were used in the two measurements. The results are given in five pairs of curves, which show that the action of the motor with a pointed curve is appreciably more unfavorable for all loads than when run with currents with flatter curves; the only exception is for small loads, for which the curves differ from each other in the opposite direction; these results are therefore diametrically opposite to those which he obtained with transformers. The curves for the primary input intersect each other at a point near to the one representing no load, which shows that even with small loads the input is less favorable for pointed curves; when run with the Siemens machine it was possible to take 15.5 per cent. more energy from the motor without stopping it; the primary currents at the maximum output of the motors were almost exactly equal, notwithstanding the fact that the outputs were quite different; the efficiency for small loads was a little better with the pointed curves, but for larger loads it was appreciably better with the current from the Siemens machine, being more than 6 per cent. for the greater loads; in both cases the efficiency for an increased output falls again; the power factors with the pointed curves are lower for all loads; that is, the current for a definite amount of power becomes greater; the loss in the leads is also greater for the pointed curves; the speed for the same load is smaller when the pointed curve currents are used, there is therefore a greater slippage.

Armature Reaction and Loss of Voltage. BEHREND. *Elek. Zeit.*, Nov. 12.—A communication regarding the recent articles of Rothert (see *Digest*, last week). He intimates that the suggestions made by that writer are by no means new, and calls attention to the articles by Behn-Eschenberg, one of which was published as early as 1892, giving him credit for having suggested this method; he points out a few corrections that should be made in Rothert's article; in alternating-current machines that writer uses the mean value of the ampere-windings in the armature, while he should have used the maximum value, as the number of lines generated in the armature are proportional to the maximum ampere-windings around it.

Armature Reaction in Dynamos. ZIEHL. *Elek. Zeit.*, Nov. 12.—A reply to that of Rothert (see *Digest*, Nov. 21 and 28) regarding the criticism of the latter's recent article; he does not attack Rothert's theory, but endeavors to adapt it to his own. Regarding the method suggested by Braun (see *Digest*, last week) he states briefly that it is absolutely useless.

Alternating-Current Machinery. *L'Ind. Elec.*, Nov. 10.—A long, well-illustrated article on the motors and alternators made by Ganz as exhibited at the recent exhibition in Budapest; illustrations are included of several induction motors for single-phase circuits, and diagrams showing the method of winding and starting.

The Hutin & Leblanc Alternator. GUILBERT. *L'Ind. Elec.*, Nov. 10.—A descriptive article which appears to be the same as the one noticed in the *Digest*, Nov. 21.

Changing the Speed of Series Motors. BAXTER. *Amer. Mach.*, Nov. 26.—An illustrated description of a method in which the coils are subdivided into sections.

LIGHTS AND LIGHTING.

Resistance of the Electric Arc. FRITH and RODGERS. *Phil. Mag.*, November; reprinted in full in the Lond. *Elec.*, Nov. 13.—A reproduction in full of the paper abstracted in the *Digest*, June 6; it is not followed by a discussion. (This is the article which gave rise to the long subsequent discussion in the Lond. *Elec.*, concerning the negative resistance, which discussion was fully abstracted in the *Digest*.)

Resistance of the Electric Arc. GRAY. Lond. *Elec.*, Nov. 13.—A further communicated discussion of the paper of Frith and Rodgers (see above). While their method may still stand in need of justification, it has not, so far as he can see, been shown to be wrong by the results; probably what the method gives is not a measure of the resistance of the arc properly so called; the resistance of the arc in the proper sense of the terms that corresponding to the dissipation, but the resistance apparent to any electric test that could be applied gives the sum of two quantities, one of which may quite conceivably be negative and numerically greater than the other, which is essentially positive, and in that case the resistance determined experimentally would appear to be negative. He considers the results of great interest, and hopes the investigation will be continued.

Cost of Electric Lighting. Lond. *Elec. Rev.*, Nov. 13.—The beginning of an article in which the real cost of electricity is ascertained by inquiring from consumers what they formerly paid for gas and what they now pay for electricity; the results far exceed the most sanguine expectations and in no matter what town, there are numerous consumers whose electricity costs them no more than gas, while it is probable that with electricity the illumination was even greater; the use of gas involves unpreventable waste while economy is possible with electricity. The answers from a number of consumers are given; one of them, the owner of a theatre, states that the light costs him considerably less than when he used gas, although the gas cost only 65 cents per 1000, and he uses two arc lights at the entrance where no lights were used before.

Jandus Lamp. KOERTISS and MATHIESEN. Lond. *Elec. Rev.*, Nov. 13; a continuation of the correspondence.—They state that the tests of Houston and Kennelly refer to the intensity of the light, while the present writers measured the illumination. They deny that the lamp which they used was not properly put together.

Car Lighting. MOSKOWITZ system. *Elec. Eng.*, Nov. 25.—An illustrated description of the system noticed in the *Digest*, Nov. 14.

POWER AND HEAT.

Prize for Power Ploughs. *Elek. Zeit.*, Nov. 12.—A statement of the conditions for the awarding of a prize which has been offered by the German Agricultural Society for ploughs operated by power other than from animals; the conditions are given fully.

Electrically Driven Ladder Dredge. Lond. *Elec. Rev.*, Nov. 13.—An illustrated description of one used in Spain, noticed in the *Digest*, Oct. 31.

New Reducing Gear. Lond. *Elec. Rev.*, Nov. 13.—A description of one mentioned in the *Digest* last week, with additional illustrations.

Electricity vs. Compressed Air. SEARING. *Elec. Eng.*, Nov. 25.—An article in which he gives the results of a practical test of both systems operated under similar conditions at a coal mine in Colorado. A year ago he was called upon to find the possible saving by substituting electricity for the existing compressed-air plant; tests of the latter were made, and an electric plant has been installed, both being worked together; a description of both is given. Tests show that the efficiency of the compressed-air system is 9 per cent. between the steam cylinders of the compressers and the water discharge of the pumps; to operate the three compressors required 35 tons of coal per day. The electrical installation displaces a number of engines, and about 1000 feet of steam pipe, in which the condensation was not small; for over a month the two plants have been working side by side; the efficiency of the electrical plant, from the steam engine cylinder to the water discharge of the pump, was found to be 50 per cent.; under normal conditions he believes it will be close to 60 per cent.; formerly the pumps required 312 horse-power and 8 boilers, but this can now be done with 56 horse-power and one boiler, even without a compound engine or condenser.

Niagara-Buffalo Power Transmission. DUNLAP. *Elec. Eng.*, Nov. 25.—An illustrated description of some of the apparatus. The *West. Elec.*, Nov. 28, also contains some illustrated descriptions.

Furnace. BORCHERS. *Jour. Fk. Inst.*, November.—A reprint of the illustration, with a brief description of the electrical assay furnace for separating gold and silver mentioned in these columns some time ago.

TRACTION.

Roller Bearings for Railways. CARUS-WILSON. Lond. *Elec.*, Nov. 13.—A communication (from the McGill University, Montreal) regarding the question raised in that paper some time ago (see *Digest*, Oct. 31) as to whether the advantage of using roller bearings on the Liverpool line could be as great as was claimed. The question is whether it is possible by the substitution of roller for ordinary bearings to increase the weight of a train 50 per cent. and to start up in the same time as before without requiring more current. This he discusses mathematically in a very sim-

ple way, taking the ratio of the ordinary friction to that when using roller bearings as five to one, and finds that the ratio of the total tractive effort to the friction tractive effort with the old bearings must be 2.6; if this is the active ratio then the weight of the train may be increased by one-half, the train starting with the same acceleration as before. He shows that if the motors were in parallel throughout, the desired end might be attained, and then discusses the question of how far the series period influences the result. The results of his calculations are given in a table for the ordinary bearings and the roller bearings; this shows that although the acceleration with roller bearings is smaller, yet the time occupied by covering the first 400 yards is about six seconds less owing to the high final speed; if the train is considered as started when the resistance on the parallel notch is all out the advantage of the roller bearings is not so marked; the results would quite justify the proposed change especially when it is remembered that the average distance between the stations on this line is about 740 yards.

Electric Traction on Railroads. Lond. *Elec.*, Nov. 13.—An editorial discussion of the possible advantages of using electric power to replace steam on railroads; with the exception of some data it appears to contain no new argument. It is pointed out that the question of fuel consumption is by no means of paramount importance, the main question being a comparison of the financial efficiencies of the two systems; some figures are given for the cost of operating steam railroads and electric railways and it is shown that even in Europe electric traction on railways have given financial results which not even trunk steam railroads can surpass or rival; on the Douglas-Laxey electric railway last year the ratio of the total working expenses to the revenue was only 38.2 per cent.; the total expenditure was only 23.28 cents per train mile, while on the Liverpool line this last figure was even still better; with steam, light railways in the United Kingdom, the ratio of working expense to revenue varies from 52 to 143 per cent. and for 20 lines averages 88 per cent. or more; on the Liverpool and City & South London line it is 60 per cent.; the actual working expenses of the 20 steam lines averages 57.2 cents per train mile as compared with 28 to 30 on the Liverpool line. Concerning the trunk railroads it is stated that the average expenditure is about 52 per cent. of the revenue while the locomotive expenses are about 15 to 16 per cent. It is not advocated that electric traction might be applied to trunk lines with such results, but it is claimed that the results are not so much superior to what has been done electrically as to justify the belief that electric traction will never be able to compete with steam on such lines.

Accumulator Cars in Paris. *L'Ind Elec.*, Nov. 10.—A note stating that an interesting application of accumulators has just been made in Paris on four lines. There are 35 cars, each weighing 14 tons with passengers; the accumulators are never taken from the cars; the charge is sufficient for a return trip, which represents about 12 to 15 km and the accumulators are recharged in 15 minutes at the terminal; the cars will seat 52 passengers; there are 200 Tudor cells of five plates each, the plates weighing 15 kg, and the entire battery complete 3600 kg; the speed is limited to 12 km per hour in the city and 16 outside; the guaranteed capacity is 32.5 ampere-hours; the charging is done at 120 amperes.

Heilmann Locomotive. Lond. *Elec. Rev.*, Nov. 13.—A short article stating that it is now reported that on the new Heilmann locomotives the reciprocating engine is to be abolished altogether and replaced by a steam turbine; it is thought, editorially, that this is going further than is necessary to secure sufficient balance; it is also thought that the steam turbine is not suited for work except as a condensing engine and it will be difficult to get condensing water on a locomotive.

Proposed Underground Railway in London. Lond. *Elec. Eng.*, Nov. 13.—A reprint in full of Baker's report concerning this proposed electric railroad underneath the present steam railway from Mansion House to Earl's Court; an abstract including an estimate of the cost is contained in the Lond. *Elec. Rev.* and a briefer one in the Lond. *Elec.*, Nov. 13.

Disturbances Due to Railway Return Circuits. VAN VLOTEN. *L'Elec.*, Nov. 7.—A continuation of his long serial. He discusses the litigation in Leeds, England, and begins the subject of corrosion.

Motor Car Regulations. Lond. *Elec. Eng.*, Nov. 13.—A reprint of the regulations just issued by the Local Government Board in London; an abstract of some length is published in Lond. *Elec. Rev.*, and a brief summary in the Lond. *Elec.*, Nov. 13.

Jungfrau Railway. Lond. *Elec.*, Nov. 13.—An abstract of the article noticed in the *Digest*, Nov. 21; it gives the table of the routes and that of the power consumed, besides some of the other data.

Power-Station in Brooklyn. MULLIN. *Elec. Doings*, November.—A short illustrated description of the Kent Avenue station containing four generators of 1500 horse-power each.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Hastings Switching Apparatus. Lond. *Elec.*, Nov. 13.—A description of this station with special reference to a novel form of switching apparatus designed by Andrews, which is described in detail and is used to facilitate running the alternators in parallel. It is a single-pole switch; to switch machines into parallel a handle is brought down, lifting a weight to its highest position where it is held by a catch closing some contacts; the handle is then turned to a nearly vertical position leaving the weight free to fall when released; when the machines appear to be in step the switch is closed by the handle and if the machines are not in phase the abnormal current releases the weight which falls and thereby interrupts the circuit; it is thus only necessary to repeat the operation once or twice until the contacts remain closed. It also cuts out the machine when the energy is being returned into the machine; this is accomplished by a shunt-winding in addition to the series-winding and connected to the bars; half is wound in one direction and half in the other; when running normally the currents will be in the same direction in the lower half of the solenoid, thus producing a magnetic field only below the core, which will tend to lock the catch, while in the other case it will produce a field at the top which will release the weight. There is an ingenious arrangement of a catch which requires only a small pull to release a heavy weight, the pull being 1 oz. for a weight of 1 cwt. Some photographic curves are reproduced of the current rushes through the switch when an alternator is switched on; with this switch two machines may safely be used while the load is small, whereas three were required before. The method of charging adopted is to require one shilling per quarter to be paid per 8-cp lamp lighted simultaneously as shown by the indicator, and 12 cents per unit used; this station has a capacity of 9000 lamps of 8 candle-power besides 52 arcs.

Electricity in Breweries. GOERLING. Lond. *Elec. Rev.*, Nov. 13; an abstract of a paper from the German.—He favors the use of continuous currents as they may be used for electro-chemical purposes and permit the use of accumulators, which are considered to be of great value in brewery works where the consumption of power varies very greatly. The atmosphere is usually moist, thus requiring great care with the wiring. The German regulations in these cases admit of a lower insulation resistance, but the wires must be provided with a fire-proof and moisture-proof covering; rubber or okonite covered wires on large bell insulators should be used, and the iron brackets should be zinc coated, while a good insulated wire should be used as a binding material; the incandescent lamp sockets should have strong porcelain bases; portable lamps should be avoided and if used the wires should be placed in a rubber or steel wire spiral tube; plugged contacts should be provided with a cover; wood and fibrous substances should be avoided, and even hard rubber should not be used; the base of the lamp should be fastened with material that absorbs no moisture and not with plaster of paris; neither cut-outs nor safety fuses should be placed in the moist rooms; the cellar compartments should be provided with separate wires from the switchboard. In the brew house the best illumination is the arc light supplemented by incandescent lights; if possible the lights for the malt kilns should be placed outside of the room in openings covered with strong glass. He favors the use of the electric motor.

Boosting with Alternating Currents. RUSSELL. Lond. *Elec.*, Nov. 13.—He discusses the theory and illustrates it by experiments. He considers the method a valuable one; it can be roughly described as adding or subtracting the secondary E. M. F. of a transformer to or from the primary, which is done by connecting the primary to a secondary terminal, taking the pressure between the other two terminals when the primary is in the supply circuit. He first considers air-core transformers and then those with iron cores, in which latter case the formulas are only approximate, but fairly accurate with sinusoidal currents; when experimenting with the latter kind the ammeters must be short-circuited to prevent them from being damaged by possible impulsive current rushes at the moment of switching on. The article gives a general solution of the problem and the formulas, but draws no general conclusions; this is followed by some experimental data with a small transformer. He also considers compensating choking coils. To use an ordinary choking coil with arc lamps he believes to be a most extravagant procedure when ampere-hour meters are used, while even watt-hour meters behave erratically under these conditions; compensating choking coils or special small transformers should be used instead.

Manchester Ship Canal. Lond. *Elec. Rev.*, Nov. 13.—A brief illustrated description of the lighting plant; there seems to be nothing of special interest in the plant; a high-tension alternating current of 1000 volts is used and transformed down to 100 for incandescent lighting, and 525 volts for the two "long" series arc circuits; there are also dynamos for continuous current arc-lamps.

Nice. Lond. *Elec.*, Nov. 13.—An abstract of the article noticed in the *Digest*, Nov. 7.

Bury. Lond. *Elec. Rev.*, Nov. 13.—A description of this plant (see *Digest*, last week) with an illustration of the accumulator room.

Insurance of Central Stations. MOMSON. Lond. *Elec. Rev.*, Nov. 13.—A communication criticising the recent views of an insurance officer, especially the one stating the idea that fire risks can be dealt with individually, is wholly impracticable and that they can only be combined as a class. He states that in the insurance of lives, each applicant is dealt with individually and either accepted or rejected, and he suggests that the same argument would apply to central stations; a thorough survey of

every station should be taken, and those that are not safe should be declined at any price.

Waterproof Apparatus. Wirt. *Elec. Eng.*, Nov. 25.—He describes a peculiar performance of a waterproof casing which was composed of a brass shell fitting closely over a base plate, into which it was found that water entered; the joint was not airtight and it is supposed that the temperature variations caused the air to expand and contract, sucking in some water around the edge while contracting. It is altogether a mistaken idea that dampness can be excluded from the interior of a box when the seal is not absolutely airtight; the interior will always have the average humidity of the external atmosphere.

Philadelphia. Elec. Eng., Nov. 25.—An illustrated description of the power plant of the new Southern Electric Company's station; it is limited almost entirely to the mechanical engineering features. The article states that the arc-lighting service of Philadelphia is perhaps the most complete and extensive of that in any American city.

Producer Gas Engine Electric Plant. Inventors' Record, October.—An illustrated description of a plant in an iron foundry in Glasgow which is of interest on account of the large gas engines used; there will be three of these of 120 brake horse power each.

WIRES, WIRING AND CONDUITS.

Calculation of Railway Circuits. Proposto. *L'Elec.*, Nov. 7.—A brief abstract of the article noticed in the *Digest*, Oct. 3, including the final formula.

Aluminum for Conductors. Eng. News, Nov. 26.—A note stating that aluminum is used for the conductors in the aluminum works of the Pittsburg Reduction Company, at Niagara Falls; the conductivity is given as 54.2 as compared with 100 for copper; to carry the same current as a copper rod of one square inch would require 1.845 square inch of aluminum and this would weigh 0.556 times as much as the copper; the cost of the conductors would be the same if the cost of aluminum per pound is 1.8 times that of copper (the difficulties encountered in soldered connections are not mentioned).

Telephone Conduits and Subways. Wietlisbach. *Elec. Eng'ing*, November.—A long illustrated article in which he discusses and describes each of the three systems into which he divides the subject, the first being the simple construction in which the wires are laid directly in the ground; the second, the subway construction in which there is a passage under the street large enough for men to walk through, and thirdly, the conduit construction in which there are manholes connected by ducts through which the cables are drawn.

Report on Brooklyn Subways. Elec. Rev., Nov. 25.—The beginning of a reprint of the complete report of the Board of Commissioners of the electric subways of Brooklyn.

ELECTRO-PHYSICS AND MAGNETISM.

Röntgen Tubes. Dorn. *Elek. Zeit.*, Nov. 12.—He points out two points which have given some annoyance; there is generally no good indication of the condition of the tube with reference to the kind of Röntgen rays which are being developed and the fluoroscope does not give a complete indication of these; the tubes also change while in use. In order to judge of the condition of the vacuum, Lenard used a parallel spark gap; this device is not as common with Röntgen tubes as it ought to be; the present writer has used it since January with very good results; this spark gap must be arranged so that the distances may be readily adjusted while the tube is in action; with an increasing vacuum the permeability of the rays increases; photographs of comparatively thin portions of the body, like the hand, show good results with a three to four cm spark gap; the thicker the parts of the body the greater should be the spark gap; a long spark gap of five cm and over is necessary for perceiving the Röntgen rays directly by means of the eye; many tubes will not stand more than eight cm and the parallel spark gap can therefore be used also as a safety device; to regulate the vacuum in the tubes he places a small piece of caustic potash in a portion of a tube provided for the purpose and melts it when the exhaustion is begun, the vacuum being made slightly higher than necessary before the tube is melted off from the pump; when in use the tube is connected with the parallel spark gap of the desired length and the portion containing the caustic potash is then heated while the current is passing, until sparks no longer pass over the spark gap; on cooling, sparks will again pass and additional heating will be necessary; with this arrangement it is possible to use the same tube for a number of different spark-lengths without any difficulty or tedious manipulations. The use of caustic potash is better than a third anode of palladium as with the latter it is only possible to reduce the vacuum, which then remains in that condition for a long time.

Generation of Intense Röntgen Rays. Rosenthal. *Elek. Zeit.*, Nov. 12; an abstract of a recent lecture.—He favors the use of large induction coils as distinguished from the Tesla system, high-tension alternating-current transformer or influence machines; it is generally assumed that the results are better the more rapid the frequency of the interruptions, but this is not the case; it applies to the rapidity of taking photographs, but there is another point to be considered, as the tubes become heated, and this heating is greater, the higher the voltage and the greater the frequency; in order not to exceed a certain allowable heating the voltage must be smaller the higher the frequency, and as the intensity of the rays increases with the voltage the product of the intensity, and the time for the same heating effect may become smaller for a higher frequency than for a lower one; it follows from this that for each tube there is a best frequency, and for this reason the induction coil ought to be capable of being regulated through wide limits. The best frequency for photographic purposes will also be a different one than for the fluoroscope, as with the latter the frequency must be sufficiently great to give a continuous image. The Tesla coils have the advantage when it is desired to use relatively small coils and when the life of the tube is of considerable importance, although the efficiency of transformation in the Tesla apparatus is much lower, yet the Röntgen rays have a greater penetrating power than those from induction coils. He describes an experiment showing that there are different kinds of Röntgen rays, those which excite more fluorescence on the screen and have less penetrating power and those which give less fluorescence and have greater penetrating power. He enumerates briefly the large number of conditions affecting the generation of strong rays; he also advocates the use of some material in the tube by the heating of which the vacuum can be regulated as desired.

Wave-Length of Röntgen Rays. Lodge. Lond. *Elec.*, Nov. 13.—A brief communication stating that, pending further information, he suggests that it is more likely that Fomm (see *Digest*, Nov. 21 and 28) has been deceived by the appearances due to reflection such as have been noticed several times by other observers, than that he has measured the wave-length of X-rays through a sort of fortunate accident.

Cryptoscope Screens. Salvioni. Lond. *Elec. Eng.*, Nov. 13; abstracted briefly from *L'Elettricita.*—He gives the comparative values of various salts for the preparation of fluorescent screens; they were compared by varying the density of the radiation by changing the angular direction of the screens. Different samples of barium-platino-cyanide differ by 40 per cent.; the same potassium salt is about one half as effective and the calcium salt less than a quarter; tungstate of calcium was about one twentieth as strong as the best samples of the above barium salt.

Interrupter for Induction Coils. Meylan. *L'Elec.*, Nov. 7.—An illustrated description of a new form of interrupter which is now used on all the coils made by Gaiffe in Paris. The interrupting hammer is a piece of metal in a vertical position, the upper end of which vibrates while the lower is secured to two horizontal flat pieces of metal rigidly fixed at their extremities; the vibration thus depends on the elasticity of torsion of the two springs, whereby a greater speed in the interruption is obtained; with this device and 16 to 18 volts a coil under ordinary conditions will give 20 to 25 cm spark. To provide against the sticking at the contact, as also to obviate the necessity of keeping the surfaces flat, the adjustable contact is mounted so as to form the centre of a revolving shaft which is turned by a small electric motor; the other contact is stationary; by this means a continuous rotation of one of the contacts is provided for; such a contact-breaker will operate continuously and has done so for 10 months; there is also the usual adjustable screw to provide for the wearing off of the contact points; the motor requires 10 to 12 volts and 0.6 ampere and is connected to the same source as that for the primary coil; it is connected in parallel to this coil and contains two choking coils in series in its circuit, which choke the extra current; in addition to this there is also a condenser shunting the primary coil.

Tesla Apparatus. Ernecke. Lond. *Elec.*, Nov. 13; noticed briefly from the *Zeit. f. Instrumentenkunde*, No. 10.—A description of a simple apparatus without oil insulation; it consists of a large Leyden jar in the secondary circuit of an induction coil and a circuit made up of a zinc spark gap and a low-resistance coil through which the jar discharges "various coils can be introduced into the low-resistance coil to make up the secondary transformer." It is claimed that an induction coil of only 10 cm sparking distance will suffice to show all the characteristic Tesla phenomena.

Laboratory Experiments. Speed. *Rose Tech.*, November.—Some brief suggestions for experiments. A platinum wire of several ohms, when immersed in acidulated water while a current is passing through it, such that there will be a drop of several volts, will evolve gas at the two ends, the evolution becoming less toward the centre; he suggests that if the points can be noticed where the wire gives off no gas, an approximate determination of the limiting voltage for the decomposition of water might be obtained. A similar experiment might be made with a copper wire in a solution of sulphate of copper, noticing the points where deposition and dissolution stop. He suggests repeating the experiments with alternating currents and also with high-frequency currents. Another suggested experiment is to fill two thin flasks with mercury or concentrated sulphuric acid, place them within a few inches of each other in a solution of sulphate of copper and subject them to several thousand volts, after which the liquid around the flasks is drawn off and examined for copper or free acid; "the question arises of a solution concentrator similar to the Edison ore separator, based on electrostatic selection of the parts of a liquid."

ELECTRO-CHEMISTRY AND BATTERIES.

Electro-Deposition of Zinc. COWPER-COLES. Lond. *Elec. Rev.*, Nov. 13; an abstract of a recent paper.—He obtained good, bright deposits from a solution of 40 ounces of zinc sulphate, sp. gr. 1.1770 and five ounces of ferrous sulphate to the gallon of water, the anodes being lead; the iron salt should be brought to the ferric condition, as no deposit of iron can be obtained from a solution of a ferric salt; the generation of hydrogen at the cathode reduces the salt to the ferrous condition, which is again converted into the ferric by the oxygen at the anode, thus considerably reducing the formation of the zinc sponge; thin coatings obtained from the acid solutions are very adhesive when the surface is properly prepared; a continuous adherent coating is not obtained if the thickness is greater than 1.5 ounces per foot of the iron or steel; a suggestion is made that the surface be quickened with a mercury deposited electrolytically. The zinc can readily be deposited free from holes when the proper density and strength of solution are maintained; the presence of free acid accelerates the formation of sponge; according to the post office tests electrically deposited zinc on iron and steel resists the corroding action of sulphate of copper as well, if not better, than when galvanized. He enumerates the troubles experienced in the electric process, and describes a plant for depositing zinc in iron sheets; the solution for this is regenerated with zinc dust which is dissolved by the free acid, this being the only proper method of keeping the electrolyte in working order, as the use of mere zinc anodes fails to keep the solution at its normal strength; the best anodes are those of lead; the economy of using zinc dust is considerable, as it is cheaper than rolling zinc anodes. The paper is thought to be an extremely valuable addition to the knowledge on the subject; it seems to provide a means for utilizing the waste in places where enormous quantities of the sulphates and other salts of zinc are annually wasted.

Solution and Electrolysis. WHETHAM. Lond. *Elec. Eng.*, Nov. 13; an abstract from a note discussing a recent article by POYNTING in the October number of the *Phil. Mag.* He considers the evidence in favor of the view that opposite ions of an electrolyte are dissociated from each other is enormously strong, although there is no reason to suppose that the ions are not united to the solvent; he gives the chief points in favor of their freedom.

Purification of Sugar Juices. *L'Elec.*, Nov. 14.—An abstract of the recent discussion of this subject at the Geneva Congress. (See *Digest*, Sept. 5.)

Carbon Generator. JACQUES. *Harper's Mag.*, December; noticed briefly in the *Elec. Eng.* and *Elec. Rev.*, Nov. 25.—A description of his invention, which has been fully described in these columns; some of the criticisms which have been made against his apparatus, although not mentioned, are answered indirectly. That the current was due to a chemical combination of the oxygen with the carbon "there could be no doubt"; quantitative tests showed that oxygen was taken from the air, that carbon was consumed and that carbonic acid was formed; the E. M. F. agreed almost exactly with the theoretical one; that it was not a thermo-electric action is claimed to have been proved by the fact that when the whole apparatus was enclosed and kept at a uniform temperature the maximum voltage and current were obtained; later experiments are said to have shown that the energy obtained is substantially equal to that corresponding to the weight of the carbon consumed, Only comparatively small generators have yet been built; with larger sizes there should be a better efficiency. The following results were obtained from a 2-hp generator; the average net electrical horse-power 2.05, carbon consumed in the pots per electrical hp-hour 0.223, coal consumed on the grate per electrical hp-hour 0.336; the electricity obtained from 1 pound of coal, of which 0.4 was consumed in the pots and 0.6 on the grate, was 1339 watt-hours, or 32 per cent. of that theoretically obtainable; the efficiency is therefore said to be 12 times greater than that of the average electric light and power plant and 40 times greater than for plants of a corresponding size.

Determination of Zinc in Sawdust. MOORE. *Elec. Eng'ing*, November.—Treating tires or conduits with chloride of zinc is considered to be one of the most effective ways of retarding decay, and as this method is being used frequently it is important to determine the amount of zinc solution which has been absorbed; in the present article he describes what he has found to be a very accurate method; the sawdust obtained from several cuts is analyzed chemically.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Compensating the Self-Induction of Wattmeters. DANIELSON. *Elek. Zeit.*, Nov. 12.—A description of a simple method for compensating for the self-induction in the voltage coil of a wattmeter; it is well known that the self-induction of this coil introduces an error which may sometimes be so great that a correction becomes necessary; one method consists in the use of condensers, but so far as he can learn it has not yet been used in practice. In the present system two additional coils are wound exactly like the voltage coil in the wattmeter; these two coils are so placed that there is no mutual induction; they are connected in series with each other and with an adjustable resistance, their circuits being then connected in parallel with the voltage coil in the instrument, which also has an adjustable resistance in series with it; these two parallel circuits are then connected to the terminals at which the voltage is to be measured in series with another adjustable resistance; all these three adjustable resistances must be inductionless, and all the three circuits, namely, the two which are in parallel and the resistance which is in the main voltage circuit, must have exactly the same resistance. The effect of this combination he discusses by means of a vector diagram, with which he shows that the current in the voltage coil of the wattmeter has almost exactly the same phase as the voltage itself; he illustrates this with an example showing that the error due to the phase shifting is very greatly reduced with this method. He also discusses briefly a second source of error, showing that the current strength should be the same when a continuous current is used. He does not recommend the method for scientific purposes, but thinks that in electrical laboratories of factories it can be used to great advantage, as it is not necessary to measure any self-induction coefficient, but merely to wind two additional coils just like the one in the instrument.

Photometric Measurements. LUMMER and BRODHUN. *Zeit. f. Instrumentenkunde*, No. 10; abstracted in the Lond. *Elec.*, Nov. 13.—They investigate the validity of the photometric measurements based on Talbot's law and carried out by means of the rotating sector. The six chief methods of varying the intensity of light from a source consist in altering its distance from the screen, or interposing a Nicol prism, a concave lens, an adjustable diaphragm, an absorbing substance, or a rotating sector; the last has many advantages; it is superior to absorbing screens like smoked or ground glass in being independent of the color, to the Nicol in being independent of any polarization already existing, and to the other methods by its independence of the size of its luminous surface and the simplicity of the calculations involved. The only question is as to whether Talbot's law, which forms the guiding principle of the rotating sector, is strictly true. The law maintains that when a portion of the retina is excited by regular periodic impulses of sufficiently frequent recurrence, a continuous impression is produced equivalent to what would be produced if the impulse were evenly distributed over the whole period. This law has been doubted by various authorities, but the Reichsanstalt investigators quote experiments to prove that it holds good within the limits of experimental error. They varied the number of interruptions from 27 (the minimum to produce continuity) to 200, and found the intensity to remain the same so long as the area of the open sector was constant. To test the law connecting intensity with aperture, they used an incandescent lamp with a straight filament and applied the inverse square law; they also used two strictly equal lamps, one of them, shining through a sector of 90 degrees aperture, giving the same intensity as both shining through 45 degrees; the errors were under one half per cent. in every case. This result in conjunction with Simon's photographic method of registration, recently described, should bring us within sight of a complete solution of the photometric problem.

Measuring the Insulation Resistance of House Wiring. MAY. Lond. *Elec.*, Nov. 13; a brief abstract of an article noticed in the *Digest*, Nov. 14.—With the exception of the diagram it contains but little more than was given in the abstract in these columns.

Geometric Proof of the Three-Volt Meter Method. ALIAMET. *L'Elec.*, Nov. 14.—A brief geometric proof of the Ayrton and Sumpner method.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephone Trunk Line Systems in Great Britain. GAVEY. Lond. *Elec. Rev.* and *Elec. Eng.*, Nov. 13; the beginning of a reprint of an institution paper.—He discusses the theoretical principles involved in the erection of balanced telephone circuits. The conditions which are necessary to obviate interferences between two neighboring circuits, at least one of which is a metallic loop, are as follows, each circuit, which has a great length compared with its depth, being considered to consist of two sides alone, the ends being negligible: Each of the wires of one loop should maintain an average equal distance from each of the wires of all neighboring loops; the two conductors of each loop should be of the same material, and should have the same conductivity; each half of the circuit, including the apparatus in the direct circuit, should have the same coefficient of self-induction, similar electrostatic capacities, and the same degree of insulation; the resultant faults due to loss of insulation should be in the centre of the wire of the loop, but if not there, each should occupy similar positions at equal distances, electrically, from the extremities. It is far easier with open wires to balance magnetic than static disturbances, as the conditions are more easily controlled. He describes the present practice in England for continuously changing the position of the wires on the same pole.

Speed of Telegraphing and Telephoning. *Elek. Zeit.*, Nov. 12.—A note giving the results of a speed test made on the occasion of the recent fiftieth anniversary in Belgium. In the course of one hour the following speeds were obtained: Morse sounder, 27 words per minute; with the telephone, 38; with the Hughes apparatus, 40; with the Morse transmission a number of different languages were used. Editorially it is stated that this gives an entirely wrong impression of the relative efficiency of the telephone, as with this method the speed is limited to that at which the message can be taken down, which is only a fraction of that which could be obtained with the telephone.

Telegraphy in Germany. *Elek. Zeit.*, Nov. 12.—The first portion of an extract from the official report of the German Post Office, referring to telegraphy for the years 1891 to 1895; some of the features are summarized in an editorial. Among the improvements during that time are the better utilization of the lines, the increase in the certainty of operation, the simplification of attendance and the introduction of more reliable and economical sources of current.

Durability of Telegraph Cables. Lond. *Elec. Rev.*, Nov. 13.—In a short article with this title, a brief description is given of the condition of the coast at Mauritius and Mahe.

Railroad Signals. *Elek. Zeit.*, Nov. 12.—An illustrated description of some length of a system of bell signals at grade crossings without gates, which is used on some of the local lines from Frankfort O. M., Germany; the signals are operated by contacts on the track, and are arranged for trains in both directions on the same track, being operated by means of currents generated by magnetos.

Telephone. Beaujouan system. *L'Elec.*, Nov. 14.—An illustrated description of this apparatus, which has recently been included among those which could be used on the Government lines.

Telephone Cables. Wietlisbach. *Elec. Eng'ing*, November; a continuation of his series.—He discusses retardation and gives the specifications for the so-called conference underground cables commonly used in this country and adopted by the Cable Committee in 1892; he then discusses the methods of laying cables.

American Telephone Practice. Miller. *Amer. Elec.*, November.—The current installment of this serial is on the history and theory of the battery transmitter, the various types of which are described.

Dynamo-Telegraph. Medina. *Teleg. Age.*, Nov. 16.—A reprint of the article noticed in the *Digest*, Oct. 17.

MISCELLANEOUS.

High-Frequency Currents in Therapeutics. Vigouroux. *L'Elec.*, Nov. 14.—An article of some length devoted chiefly to a criticism of the recent communications by d'Arsonval regarding the therapeutic effects of such currents. The idea of utilizing these in medical practice was originally suggested by Tesla in 1891, and is therefore not new with d'Arsonval; he quotes from the latter's writings, in which the physiological phenomena are described; it is claimed that alternating currents above a frequency of 3000 per second produce neither chemical nor physiological effects; when the alternations are very frequent the currents are said to be confined to the outside layers of the conductor, and they therefore would not penetrate deeply into the body; he therefore questions how they could have the physiological actions which d'Arsonval claims; he quotes from d'Arsonval, stating that in comparatively high resistance conductors the currents do penetrate further than merely through the surface; the human body does not act like a good metallic conductor in this respect. The present writer discusses the statements of d'Arsonval in detail, concluding that the explanations made by d'Arsonval are not satisfactory; he suggests that a more simple explanation exists in supposing that the effects produced are entirely thermic and that they can therefore be produced by simpler means; in this connection he quotes the experiments of Marmier, who showed that the action of high-frequency currents on toxines was a purely thermic one. He describes applications of electricity which he himself had made tending to show that high-frequency currents have less powerful electrical effects than franklinization; the electrical effects, he believes, are less and more limited than those produced by static electricity.

Carbide of Calcium and Acetylene. De Perrodil. *L'Elec.*, Nov. 7; a brief abstract of a recent article.—He credits the discovery to Moissan. He distinguishes between the ordinary electric furnace for metallurgical purposes in which there is no distinction between the electrolytic and the calorific actions, and those of Moissan, which he calls electrothermic; it is only in the latter kind that fused carbide of calcium can be obtained. He then discusses the properties of carbide of calcium and acetylene.

Preserving Meat by Electricity. Lond. *Elec. Rev.*, Oct. 30.—A brief account of a process devised by Pinto, in which meat is preserved by immersing it in a 30 per cent. solution of common salt and passing a continuous current of electricity through the solution for 10 to 20 hours, after which the meat is dried; 1000 kg of meat required a bath of 3000 litres and 100 amperes at eight volts, the electrodes being platinum; no further information is given.

Preserving Meat by Electricity. Haynes. Lond. *Elec. Rev.*, Nov. 6.—An interesting abstract from the "Memoirs of Andrew Crosse," published in London in 1857, showing that his experiments were made considerably before 1855. The extract refers chiefly to the electrification of water, wines, meat, etc., and describes the electrolysis of sea water, which in twenty-four hours or less "becomes perfectly wholesome to the taste and will remain sweet in open vessels for an indefinite time"; it is not only purified but is rendered antiseptic; the "application of this practice to wines and brandy has been attended with great success"; it was also "applied most effectually to stopping fermentation in cider" and in starch; such water also has the power of restoring the most putrid substances to sweetness; milk has been kept for three weeks; some fish were treated for three months and were pronounced perfectly fresh but had become quite tasteless.

Atmospheric Influence on the Magnetic Survey of Mines. Halbaum. Lond. *Elec. Rev.*, Nov. 6; a brief extract from the *Colliery Guardian*.—He noticed some remarkable experiences, of which he gives a detailed account and which he explains by saying that "the accumulative power of various atmospheric influences may be competent to cause serious errors of survey where the loose needle is too implicitly trusted"; he believes that "electric stress and electric currents are actual phenomena in a mine." The danger is said to be of some magnitude and shows that the loose needle cannot be trusted in mining surveys.

Recent Progress in Germany. Schaffler. *Elek. Zeit.*, Nov. 5.—A reprint of his address at the opening of the first Fall meeting of the Electrotechnical Society of Germany. He gives briefly a good summary of the recent progress in all the various branches of the electrical industry in Germany, and shows that the recent development has been unusually great.

Biographical. *Zeit. f. Electrochemie*, Oct. 20.—A full-page portrait of Wilhelm Hittorf, accompanied by a short biographical sketch by Ostwald.

Cardiff Exhibition. Lond. *Elec.*, Nov. 13.—A brief account of some of the exhibits, including an illustrated description of a coal cutter.

Gutta-Percha in Soudan. *L'Elec.*, Nov. 14.—A short article on gutta-percha which was discovered last year in French Soudan.

A Cheap Drying Oven. Daniell. *Amer. Elec.*, November.—A description of an oven for drying shellac or whatever insulating material is used in street railway repair work. The oven consists of a packing box 3 feet square by 2 feet deep, lined inside, first with a layer of asbestos and then with a layer of roofing tin. The oven is heated by ten 16-cp, 100-volt lamps which, it is stated, will maintain the temperature at about 220 degrees Fahr., which is about the usual temperature used for the purpose.

Upward Lighting Discharge. Macfarlane. *Amer. Elec.*, November.—In the case of two oak trees struck by lightning, the rending of the bark and splitting of the wood next to the bark was single along the trunk, but bifurcated when it came to the main branches. The fact of this bifurcation of the rent appears to Prof. Macfarlane to indicate that the discharge passed from the roots upward, not from the top branches downward.

Biographical History of Electricity. *Amer. Elec.*, November.—Alessandro Volta is the subject of the current installment of this serial.

Revolving Tower. *West. Elec.*, Nov. 28.—An illustrated description of the proposed tower for the Paris Exposition, which was referred to in the *Digest*, Oct. 31.

Electricity in Naval Life. Fiske. *Elec. Eng.*, Nov. 11.—He describes with the aid of a number of illustrations his speed and direction indicators for showing at a distance the speed and direction of the main shaft. The speed indicator consists of a sort of alternating current generator, in which the alternating currents are induced by the rotating shaft, being great or small as the revolution is rapid or slow; the indicator shows the strength of the current and therefore the speed; the direction indicator consists also of an alternating current generator operated by the moving shaft and throwing the needle of a polarized galvanometer periodically in one or the other direction; the receiver of the speed indicator is a sort of galvanometer mounted in a heavy oil, which converts the intermittent throw of the needle into a nearly steady deflection, which reads directly in revolutions per minute. In the issue of Nov. 18, he gives an illustrated description of his range-indicating system to be used with guns. In the issue of Nov. 25, he states that trial tests of the instruments have been made on some of the United States vessels for one year and have been satisfactory; the system is now installed on a number of them; some instructions regarding the sticking of the galvanometer needles are given

Electric Foot Warmer.

A new idea in electric heating, and a sensible one, is illustrated herewith It consists of a combined electric foot warmer and foot rest, and the enterprising concern that has by the production of this device contributed to the comfort of mankind is the American Electric Heating Corporation, Boston, Mass.

The device generally is of cast iron finished in black enamel. The heat is applied directly to the under side of the top plate by the enamel process, making a durable device that will stand any sort of treatment that it is likely to be subjected to. As it requires but 50 watts it may be attached to any lamp socket by means of the usual plug and cord (with which it is equipped) and can be placed in any desired location about the room or office. It is not inconvenient to move about as it weighs less than 10 pounds and never reaches a temperature, under any conditions, that would be uncomfortable to handle. In about 10 minutes after the current is turned on the foot-plate is quite warm and it reaches a maximum temperature of about 145 degrees Fahr. in from 15 to 20 minutes. The device is such that it can be used the year round as a foot rest and will add much to the comfort of those sitting continuously at a desk.

Many extravagant claims have been and continue to be made for electric heaters as means of heating rooms and offices. While in some cases they can be used to advantage, speaking generally the cost of current is too high for such work. The American Company clearly recognized the limitations in the development of heating apparatus, and is producing goods that are practical for the use for which it recommends them. For

this reason it is clear that the foot warmer will have a wide application. There are thousands of people whose occupation confines them in small booths, cashiers' offices, ticket offices and the like, through the Winter

ELECTRIC FOOT WARMER.

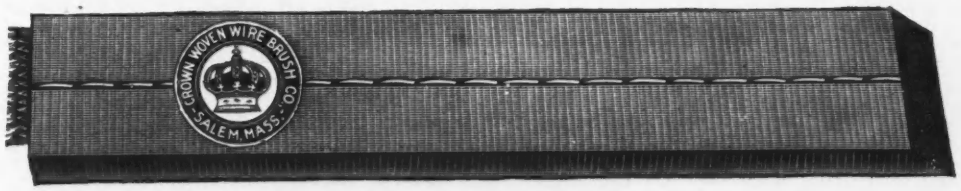
months, where it is impracticable to have a stove on account of the limited size of the compartment, and this device certainly will prove a boon to many.

Crown Woven-Wire Brushes.

The Crown woven-wire dynamo brushes, made by the Crown Woven-Wire Brush Company, of Salem, Mass., are becoming well known in the electrical trade, being used by the largest dynamo builders, central stations and isolated plants in the United States, Canada and Mexico. The Crown "K" brush, which it is claimed is the best, is very similar to the imported German brush. It is made with a core of very fine wire braided together, then woven, covered with just as fine cloth but woven after the manner of lace; it is then sewed with strong thread, which holds the cloth firmly together and prevents the brush spreading at the ends. This gives a well-ventilated brush, flexible both ways.

The Crown brush is made from the ordinary wire cloth, and is made of either bias mesh, square mesh or half and half. It can be furnished very flexible, or stiff and rigid. Most of these brushes are made of copper, but some are also made of brass and alloys.

This company is making a specialty of this business and has made it a great study to supply the trade with a first class article, and by the way its business is increasing, we should judge that it is successful in its efforts. Besides the ordinary tangent brushes it is supplying dynamo



CROWN "K" WOVEN WIRE BRUSH.

builders with many odd things for use on electrical machinery, such as flexible connections, round pencil brushes and short thick brushes for radial use on low voltage machines in place of carbon.

This company is represented in New York by H. B. Coho & Co.; Chicago, by the Osburn Electric Supply Company; Detroit, by the Michigan Electric Company; St. Louis, by St. Louis Electrical Supply Company, all of whom carry the Crown brushes in stock.

A New Type of Rheostat.

The new line of rheostats placed on the market by the General Electric Company are known as packed card rheostats, deriving their name from their method of construction.

To form a unit resistance card a wire ribbon of German silver of definite length and size is wound upon a tube of asbestos formed on a steel mandrel, and which, when the mandrel is withdrawn, is flattened and creased in a press to give it the card shape. In building the rheostat any desired number of these unit cards are placed side by side and separated by asbestos. The whole is then clamped by suitable end plates and bolts and forms a resistance section. To increase the radiating capacity of the resistance section iron plates are inserted between cards and project beyond the general surface of the section. The same general structure is followed in all rheostats and motor starting boxes of the packed card type, the cross-section and length of the resistance wire or ribbon alone being varied. The use of the flat card allows a very large resistance capacity to be placed in a small space, while the creases hold the coils firmly against displacement.

The advantages of this method of rheostat construction may be thus summarized: Absence of combustible material; exceedingly large radiating surface for weight and bulk of resistance material; chance of short

FIG. 1.—BACK VIEW OF STANDARD GENERATOR FIELD DIRECT-CURRENT RHEOSTAT.

circuit or similar troubles eliminated by complete insulation of the resistance; easy replacement of damaged cards when necessary; ability of resistance to withstand overloads; it expands and contracts freely, and as the burning of one card only impairs the use of the apparatus until a new one can be inserted, or the old one be short-circuited, no overload can destroy the rheostat.

The switches used with those rheostats differ with the use to which the device is put. The steps of the field rheostat switches vary in number from 25 to 50—the majority having 50 steps to provide for close regulation—and are mounted on 10 inch by 10 inch slate bases. The motor switches, with the exception of the three largest sizes, are also mounted on slate bases, the number of steps up to and including 10 horse-power being the same.

The starting rheostats for motors are built with or without automatic release switch, the standard switch being automatic. This automatic release is essential to the successful operation of isolated motors, for if the current stops, the circuit is automatically opened and remains open until closed by hand. The motor armature is thus protected against injury by any sudden rush of current, if the supply of current in the mains be suddenly thrown on after having been cut off, as sometimes happens with street mains. With the automatic switch the starting resistance is all in as soon as the motor is shut down from any cause.

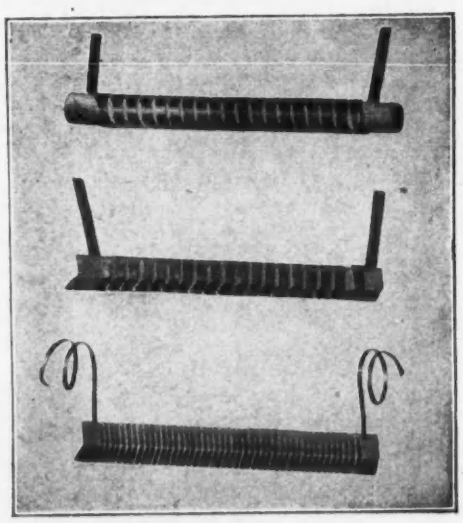


FIG. 2.—WOUND TUBE AND PRESSED CARDS.

The generator field rheostats are constructed to be mounted either in front or behind the switchboard; the motor-starting rheostat for the front of the switchboard only. The former are built for 500, 250 and 125-volt circuits, the latter for 110, 220 and 500-volt circuits; those for 110 and 220 volts being adapted for use also on 125 and 250 volts.

Electrical Plant on the Steamer "La Grande Duchesse."

On the afternoon of Nov. 23, by invitation, a large party inspected the magnificent new steamer *La Grande Duchesse* of the Plant Line, at her dock, Pier 35, North River, New York.

The electrical features of *La Grande Duchesse* are such as to merit a brief reference. One of the most notable innovations is a complete telephone exchange. Every stateroom is provided with a telephone, as is also every other important locality on the ship, and by means of this system communication is quickly available between any two points on

board. The "exchange" is in one of the deck-houses, and contains a board with 170 drops and 10 plugs. The telephone system receives its current from a battery of 12 cells of chloride accumulators, which are charged by a Crocker-Wheeler motor-generator placed in the "exchange," under the care and control of the operator. A complete switchboard is provided for effecting the proper connections and disconnections with the ship generating plant, from which is received the current for the operation of the motor-generator.

The electric light plant is located abaft the engine room in a small compartment by itself. It was designed and installed by the General Electric Company and is a very compact installation. There are two G. E. direct-connected marine sets, each consisting of a four-pole generator and a vertical compound engine running at a speed of 550 revolutions per minute. Each machine generates 180 amperes of current at 110 volts. The switchboard is of slate and is furnished with 15 circuit-switches, 2 dynamo switches, a power switch, 2 regulating rheostats and Weston voltmeters and ammeters. The ship is wired throughout on the two-wire system, for 950 lights. She is also provided with one electric searchlight.

Electric power is utilized in operating the coal conveyers, and for the purpose two 22-hp General Electric motors are installed.

The ship's running lights—that is, the mast, starboard and port lights—are provided with tell-tale indicators, which give a visible and audible indication to the pilot when any one of the three lights has become extinguished through any accidental cause. This tell-tale system is that of the General Electric Company, and was described in The Electrical World of Oct. 3, 1896.

The steering mechanism is also provided with a tell-tale device. The engines that operate the rudder are controlled electrically from the pilot house, the valves being operated by a 1½-hp Storey motor, made by the Storey Motor & Tool Company, Philadelphia. The position of the rudder at any time is shown on an electrical indicator in the pilot house. This indicator system is that of the Electro-Dynamic Company, Philadelphia.

The steamer's electrical equipment also includes a complete call-bell system, with a 200-drop annunciator, each stateroom being provided with push-button, etc. This service is of the usual character, and does not differ from that of ordinary call-bell installations. There is also installed a complete electric fire-alarm system.

The electrical and mechanical signaling systems were installed by Charles L. Cory & Sons, New York.

La Grande Duchesse is a double screw boat of 5000 tons. Her extreme length is 404 feet, beam, 47 feet 9 inches, and she is constructed entirely of steel. In case of war or in warlike emergencies she may be utilized as a cruiser, having been built with this object in view, according to Government specifications. She is fitted with two quadruple expansion vertical marine engines, the combined power of the two being 8000 horse power.

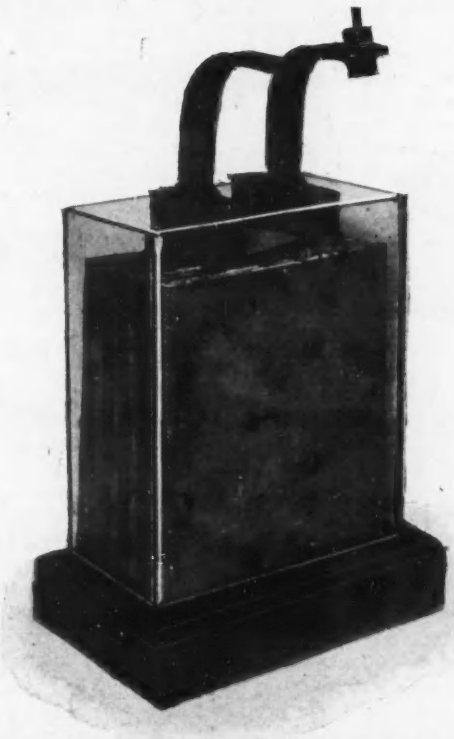


Fig. 1.—Autocar Storage Cell.

The steam generating plant consists of eight Babcock & Wilcox water-tube boilers, built to work at a pressure of 250 pounds to the square inch. The plates used in the boilers have a tensile strength of 60,000 pounds. Altogether this ship undoubtedly represents the highest development of the steamship building industry in America, and is a worthy example of American engineering skill.

La Grande Duchesse was built at Newport News, Va., by the Newport News Ship Building & Dry Dock Campany.

An Autocar Battery.

Since the legalization of mechanically propelled vehicles on the public thoroughfares of the United Kingdom was first talked of much of the best work of the leading men engaged in those branches of industry most likely to furnish a satisfactory solution of the problem has been directed to that end.

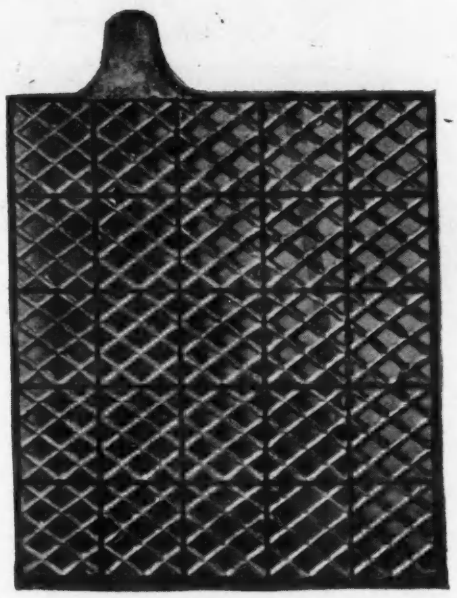


Fig. 2.—Grid of Autocar Cell.

For some years past quite a number of horseless vans and omnibuses have been constructed whose motive power was electricity, usually furnished by storage batteries of the E or E K types of the E. P. S. Company, but no great success was obtained in propelling small vehicles to carry two to four passengers by electric power. The introduction of the new Faure-King cell, it is claimed, has made the question of a satisfactory electric private carriage or bus a simple one. The weight as compared with the above-mentioned E model being reduced to little more than one half, while the construction is such that the cell, it is said, is not damaged by vibration or the highest discharge rate which can result in practice. The battery as it stands is covered by a joint patent of Camille Faure and Frank King and two patents of Frank King.

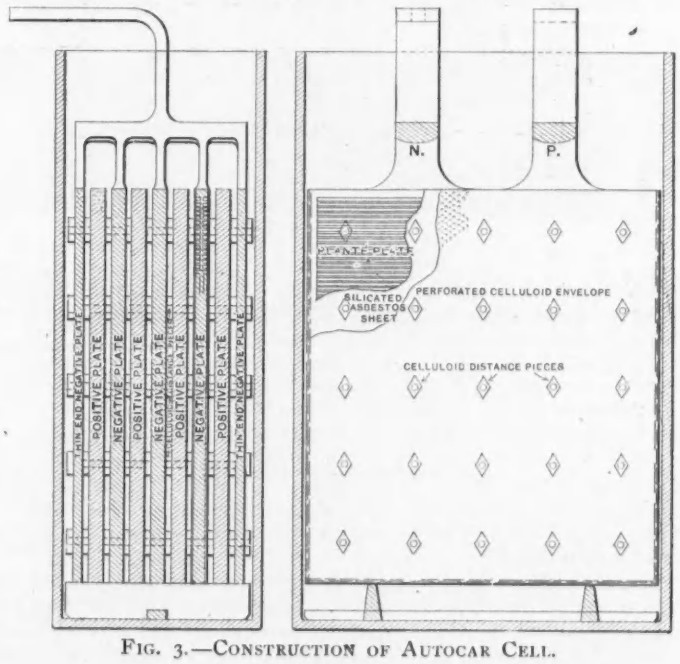


Fig. 3.—Construction of Autocar Cell.

Experiments by Messrs. King and Faure have been continually progressing during the past four years in connection with envelope electrodes and the Electrical Power Storage Company feel perfect confidence in placing the present type of cell upon the market, as it has had an ex-

tended trial of over 18 months of the hardest work in the laboratory at Millwall. Recently a cell was taken from this battery, which was then not *hors de combat*, and cut entirely to pieces. No part of the cell was entirely destroyed, and the grids and the celluloid would apparently have stood for a further period. The following sworn test report sufficiently proves how well within the mark is the claim of 4.4 ampere hours per pound total weight of cell. In all cases where the cells are not constantly worked at over dsicharge rate it will be seen that the capacity soon exceeds the figure of 150 ampere hours for 36 pounds total weight, which is claimed.

RE. SWORN TEST OF 9-PLATE FAURE-KING CELL.

I, Joseph Horsnell May, of No. 84 Westferry Road, Millwall, London, Eng., make oath and say,

That the following figures fairly represent the output from two samples at present at work in the laboratory of the Electrical Power Storage Company, Ltd., and indicate the general average result of tests of Faure-King cells which have been discharged regularly for several months at 5-hour rate, and tests of other cells which have been worked at varying rates from 40 to 100 amperes.

(Signed) JOSEPH HORSNELL MAY.

Witness signature Stamp.

LABORATORY REPORT, NOV. 12, 1896.

SUBJECT: NINE-PLATE FAURE-KING CELL.

⅛-inch Separators. First discharge Sept. 8, 1896.

Date. 1896.	Charge.					Discharge.				
	Rate amps.	Amp. hours.	Av'ge volts.	Volts. Initial	Volts. Final	Rate amps.	Sp. Gr. Initial	Sp. Gr. Final	Resistance. Initial	Resistance. Final
Sept. 8	15	150	1.94	2.07	1.80	30	1255	1215	.0026	.0053
" 9	15	147	1.93	2.06	1.80	30	1250	1212	.0026	.0046
" 10	15	150	1.95	2.05	1.80	30	1255	1210	.0026	.0046

The following results have been obtained after the cell has been continuously at work since the above date, at rates of discharge varying between 40 to 100 amperes.

Nov. 10	30	142	1.97	2.10	1.80	50	1265	1185	.0016	.0032
" 11	30	144	1.97	2.09	1.80	50	1265	1200	.0016	.0032
" 12	30	142	1.96	2.08	1.80	50	1267	1207	.0016	.0032

LABORATORY REPORT, NOV. 12, 1896.

SUBJECT: NINE-PLATE FAURE-KING CELL.

⅛-inch Separators. First discharge, Jan. 25, 1896.

Date. 1896.	Charge.					Discharge.				
	Rate amps.	Amp. hrs.	Av'ge volt.	Volt. Initial	Volt. Final	Rate amps.	Sp. Gr. Initial	Sp. Gr. Final	Resistance. Initial	Resistance. Final
Jan. 25	30	142	1.94	2.03	1.80	30	1250	1205	.0020	.0040
" 27	30	135	1.92	2.00	1.80	30	1252	1200	.0033	.0033
" 29	30	150	1.93	2.02	1.80	30	1252	1210	.0020	.0040

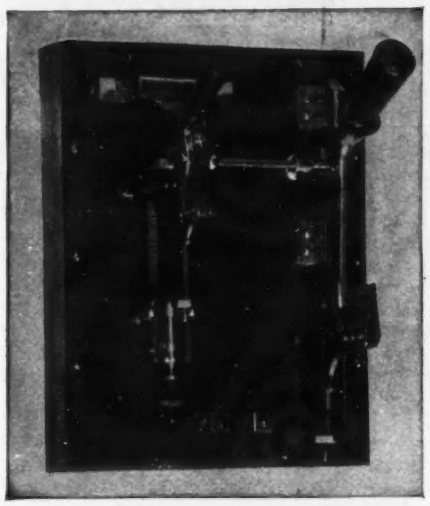
The following results were obtained after more than 10 months' continuous work in the laboratory.

Nov. 6	30	162	1.98	2.10	1.80	30	1265	1220	.0026	.0053
" 9	30	160	1.98	2.10	1.80	30	1265	1227	.0026	.0053
" 11	30	165	1.98	2.10	1.80	30	1265	1220	.0026	.0053

These tests relate to the pasted aperture type of grid as illustrated by Fig. 2. The invention may also be adapted to the original Swan type of plate either pasted or formed and shown by Fig. 3. It will be seen that the plate is wrapped first in a porous substance (silicated asbestos cloth) and afterward is placed in a close fitting envelope of perforated celluloid, the envelope being fixed to the plate by celluloid pins upon which are cemented celluloid diamond-shaped washers on either side. The pins take different positions upon the positive and negative plates. The 36-pound cell will furnish 80 amperes continuously for one hour.

Alternate-Current Machine Circuit-Breaker.

The accompanying cut illustrates an alternating-current machine circuit-breaker recently patented and now being brought to the attention of users of alternating-current apparatus by Leonard L. Elden, 305 Congress Street, Boston. The device occupies a field entirely its own and offers a means of relief to central station operators that has long been desired. To those who have been obliged to wait for the blowing of fuses to clear their apparatus of short-circuits, lightning, overloads and trouble of all kinds, and have had the unpleasant experience of having to repair a burnt armature, broken belt, a damaged engine or counter-shaft this device should appeal strongly. We are informed that for two years the breaker has been undergoing the most severe tests that could be applied and has never failed to give instant protection to the apparatus. At a recent test of these breakers at the station of the Boston Electric Light Company, it was shown that the application of a dead short-circuit at the switchboard produced no visible effect on either engine, dynamo or belt, and but for seeing the circuit-breakers open, none present would have known that a short-circuit had been applied. All the alternating machines in the stations of the Boston Electric Light Company were equipped with these breakers two years ago after exhaustive tests, aud since that time these devices have demonstrated their value in every case, saving their cost many times over in repairs at the stations and in the absence of fires on the circuits, due to arcing of double-pole switches, fuse boxes, lightning arresters, etc. The breaker is designed to be placed directly on the dynamo in a position easy of access to the operator, and forms an attractive addition to the appearance of the machine.

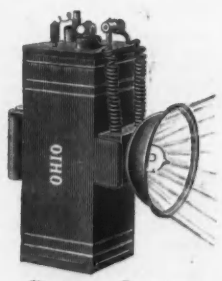


CIRCUIT-BREAKER.

Bicycle Electric Light.

The bicycle electric head light made by the Ohio Electric Works, Cleveland, O., is claimed to be one of the most serviceable and reliable lights of this class that has been placed on the market up to the present time. The lamp is self-contained; that is, it carries its own power, and has a lamp and reflector attached to the front face. It is stated that this light is giving great satisfaction, and as a holiday present perhaps nothing could be more acceptable to a bicycle rider than one of these electric lamps.

In addition to these lamps, however, the Ohio Electric Works makes a great variety of small lamps, such as cap lights for band musicians, miners and clubs. They also produce a line of miniature lamps and small electric motors, which find a large field of usefulness. The new electric student's lamp, which has recently been brought out, is attracting considerable attention and giving satisfaction, and the necktie light made by this firm continues to meet with large favor and popularity.



BICYCLE LIGHT.

The partners in the Ohio Electric Works are Messrs. Albert C. Fletcher and J. W. Hencke. Mr. Fletcher has been engaged in the electrical business for the past 20 years, and has made many inventions which have been successful, both electrically and commercially. Mr. J. W. Hencke, the junior partner, was formerly connected with the Standard Oil Company, and on account of the growth of the business of the Ohio Electric Works was induced to devote his time to the financial part of the concern. That he was a valuable addition to the business is evident from the fact that it has grown to be large and successful.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Nov. 28, 1896.

ELECTRICAL STOCKS.—There was a general decline in electrical stocks, although the losses were merely fractional. The changes are in Edison Electric Illuminating Company, of New York, which dropped 1 point; Electric Storage Battery, Philadelphia, ⅛ off; do., preferred, 1; General Electric, ⅛ The other stocks remain practically unchanged.

TELEGRAPHS AND TELEPHONES.—With the exception of Western Union the majority of stocks of this class show an improvement over last week's quotations, Western Union closing with a net loss of ⅛. Bell Telephone took a jump and closed at 209, which is 3 points higher than last week's closing quotation. Erie Telephone advanced 1 point and Postal Telegraph ½.

TRACTIONS.—The only activity in the generally dull market in street railway securities during the past week was Brooklyn City Railway. It started at 170 at the beginning of the week, and was forced up to 173, there being a scarcity of the stock. Some of the stocks, however, brought better prices than they did last week, notably among them being West End, common; Huckleberry (Union Railway) and New Orleans Traction, both common and preferred.

THE PATERSON RAILWAY COMPANY reports gross earnings for October of $24,612, a decrease of $772 as compared with the same month of last year, and net $7,750, a decrease of $3,132.

THE SCRANTON TRACTION COMPANY reports gross earnings for October of $32,215, an increase of $5,798 as compared with the same month last year, and net $16,193, an increase of $3,215.

OCTOBER EARNINGS.—The New Orleans Traction Company reports gross earnings for October of $104,195, a decrease of $15,682 compared with the same month last year, and net earnings $45,510, a decrease of $10,620.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	..	..
Edison Electric Ill., New York	100	99½	101
" " " Brooklyn	100	88	93
" " " Boston	100	..	..
" " " Philadelphia	100	..	..
Edison Ore Milling	100	7½	10
Electric Storage Co., Philadelphia	100	28	29
Electric Storage, pref	100	30½	31
General Electric	100	31⅞	32
General Electric, pref	100	70	..
Westinghouse Consolidated, com	50	25	..
" " pref	50	50	..

BONDS.

Edison Electric Ill., New York	105	105	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	92½	..

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	209	..
American District Telegraph	100	*29	39
American Telegraph & Cable	100	90	91½
Central & South American Telegraph	100	124	127
Commercial Cables	100	150	..
Erie Telephone	100	64	65½
New England Telephone	100	99½	..
Postal Telegraph-Cable	100	90	92
Western Union Telegraph	100	86½	86⅝

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	17½	17¾
Brooklyn Rapid Transit		20	21
Brooklyn Traction	100	..	14
" " pref	100	46	48
Buffalo St. Ry	100	77	79
Cleveland Electric Ry	100	..	..
Columbus St. Ry	100	43	45
Hestonville	100	51	52
" pref		..	62½
New Orleans Traction	100	11	13
" " pref	100	42	46
North Shore Traction	100	23	..
" " pref	100	75	78
Rochester St. Ry	..	17	20
Steinway Ry	..	45	50
Union Railway (Huckleberry)		100	104
Union Traction, rcts $10 pd	..	12¾	13
West End, Boston	100	67½	..
" " pref	100	87⅛	..
Worcester Traction	100	19	20
" " pref	100	92	95

BONDS.

Brooklyn Rapid Transit 5s. 1945	100	77	..
Buffalo St. Ry. 1st con. 5s	100	*107	..
Cleveland Elec. Ry. 1st mtge 5s	100	100	*103
*Columbus St. Ry. 1st 5s	100	95	100
Rochester St. Ry. 1st 5s	100	..	98
Union Railway (Huckleberry) 1st mtge 5s		*101½	105
*Westchester Electric 1st mtge 5s	100	100	103

* With accrued interest.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, Nov. 30, 1896.

STREET LIGHTING.—At noon on Dec. 15 the bids for supplying the city with gas and electric lighting for 1897 will be opened. It was decided at the meeting of the Gas Commission on Nov. 23 to put 575 additional lights in the city. The appropriation for the city's public lighting for the year 1896 is $1,087,813.

LEHIGH UNIVERSITY.—We have received from President T. M. Drown, of Lehigh University, South Bethlehem, Pa., a copy of the address on "Citizenship and Technical Education," delivered on Founder's Day (Oct. 3), by Mr. John H. Converse. From the same source we have also received several pamphlets descriptive of the various courses of study taught at this University. These courses are thorough and practical.

NEW FORM OF MOTOR FOR ELEVATED ROAD.—An elevated railway engine is being fitted up at the Manhattan Company's shop for the purpose of testing a petroleum generator of steam, owned by the Consolidated Gas Fuel Company. The trial trip will be made in about a fortnight it is stated. The use of the petroleum does away with the necessity of carrying coal. Mr. J. S. Zerbe is said to be the inventor of the system. Mr. Zerbe's invention is stated to be on trial on one of the Government torpedo-boats. He claims for it economy of fuel and simplicity of operation.

FRANCHISE AWARDED.—On Nov. 27, Comptroller Fitch awarded to the People's Traction Company the franchise for 28 miles of street railway in the Twenty-third and Twenty-fourth Wards of New York City, which are situated above the Harlem River, in Westchester County. The fight for the franchise has been a long and bitter one, and has been in the courts for over a year. Under the law the franchise had to be offered at public auction, and the sale took place Oct. 5, 1895. The bidding was very spirited, and finally settled down between the People's Traction Company and the North New York City Traction Company. The bids rapidly advanced until they reached 6975 ⅛ per cent. of the gross receipts, which figure was offered by the North New York Traction Company. At this point of the proceedings Comptroller Fitch adjourned for the purpose of seeking advice from the Corporation Counsel. The People's Traction Company demanded the award of the franchise to it on the ground that all bids over 100 per cent. of the gross receipts were illegal, and that the company's bid of 97 per cent. of the gross receipts for five years, and 95 per cent. thereafter, which with the offset price of 3 and 5 per cent. respectively, made a total of 100 per cent., was the highest legal bid. Injunctions followed each other and progress was completely blocked, until Justice Smyth dismissed the injunction on Nov. 27, giving as his opinion that the Comptroller had the power to award the franchise as he deemed best for the interest of the city, and that if any of the parties interested thought themselves injured they could have recourse to the courts. The franchise was therefore awarded, as above noted, to the People's Traction Company, at the bid aggregating 100 per cent. of the gross receipts. The North New York City Traction Company filed a protest against the award. It is stated that the People's Traction Company, if it finally secures the franchise, will run a line connecting with the Connecticut & Westchester Street Railway, and the latter road will be expected to pay the expenses of the New York road, unless a relief bill is passed by the Legislature.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., Nov. 27, 1896.

APPLICANTS FOR MORE POWER.—Mr. W. B. Rankine, of the Cataract Construction Company, says that his company has applications from its present tenants for 5000 additional horse-power and that there would be placed in position as soon as possible five instead of three more 5000-hp dynamos.

NIAGARA POWER FOR AN ISOLATED PLANT.—The Real Estate Exchange, Buffalo, in equipping its building with electrical apparatus had the Niagara power in view, and installed rotary transformers instead of dynamos. These rotary transformers are now used as dynamos operated by belted steam engines. As soon as possible they will be operated by the Niagara current direct, and the engines will be held in reserve. They are 30-kw machines and were built by the Westinghouse Electric Manufacturing Company.

TONAWANDA FRANCHISE SOLD.—A special meeting of the village Board of Trustees was held to consider the question of transferring the franchise held by the Buffalo, Kenmore & Tonawanda Railway Company. At the last meeting the company made a proposition to the trustees asking permission to dispose of its property to the Buffalo Traction Company. The franchise which was granted to the Buffalo, Kenmore & Tonawanda Railway Company in 1892 provided that the said company could not dispose of its property without the consent of the village.

POWER FOR NIAGARA ELECTRO-CHEMICAL WORKS.—The aluminum and the two chemical works are supplied with two-phase alternating current at 2000 volts from the same feeder. The aluminum works uses 3000

horse-power and the chemical works 750 horse-power, the current being transformed from 2000 volts alternating to 116 volts direct. The Niagara Electro-Chemical Works in Niagara Falls was founded in 1895 with a capital of $100,000 for the purpose of manufacturing sodium from caustic soda and peroxide of sodium, under the Castner electrolytic process. The electric power of 500 horse-power is taken from the Niagara Falls Power Company. The works are using, at present, 500 horse-power and will increase until the full capacity is reached. The static transformers are located in the transformer room of the chemical works and consist of four machines. They receive the current from the four cables in the subway at 2000 volts two-phase and transform it to 118 volts alternating. The rotary transformers then change the current to a direct-current of 116 volts.

PHILADELPHIA NOTES.

Branch Office of THE ELECTRICAL WORLD,
927 Chestnut Street,
PHILADELPHIA, Pa., Nov. 28, 1896.

ELECTRIC HEATERS.—The Globe Electric Heating Company, 141-147 North Twelfth Street, Philadelphia, Pa., has just issued a pamphlet artistically illustrating and describing its various styles of electric heaters. These heaters possess some admirable features of design and construction, and are applicable to domestic work and for street car purposes. Portable heaters also form a feature of the business.

LINK BELTS.—The Link Belt Engineering Company, Nicetown, Philadelphia, has just issued a catalogue entitled "Modern Methods As Applied to the Elevating and Conveying of Materials and the Transmission of Power." This catalogue is gotten up in excellent form, and shows all the methods of accomplishing the results indicated by the title. Apart from its value as trade literature it will be of general interest, on account of the information given regarding the various appliances used for elevating and conveying materials etc.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, MASS., Nov. 27, 1896.

MINING ENGINEERING.—The course in Mining Engineering and Metallurgy is the subject of a pamphlet just issued by the Massachusetts Institute of Technology, Boston. The course is thoroughly described and several illustrations show the methods and processes of carrying on the work.

W. D. HOFFMAN & CO., Boston, New England agents of the Stirling boiler, Slater engine, and Dick & Church engine, have removed their offices from 620 Atlantic Avenue to 19 Pearl Street, where they possess more spacious quarters for the conduct of their rapidly growing business.

THE CONSOLIDATED INSULATED TUBE COMPANY, Boston, although but recently succeeding the Builders' Insulated Tube Company, Lynn, and the Kinney Electric Conduit Company, Boston, has pushed its business organization so energetically as to already make the immediate outlook for business decidedly encouraging.

NEW PORCELAIN WORKS.—The Bryant Electric Company, of Bridgeport, Conn., will establish a branch factory at East Liverpool, O., in order that it may better compete for the Western trade. This action is taken, it is stated, on account of the high freight rates on porcelain ware used in the construction of electrical apparatus, and by the establishment of a branch at East Liverpool a large saving will be effected in the cost of manufacture.

THE PHILLIPS INSULATED WIRE COMPANY, Pawtucket, R. I., has issued a new price list of wires, including fireproof and weather-proof wire, underwriters' wire and Ideal wire all of which are made in connection with the company's well known O. K weather-proof insulated copper wire. Samples of the first-named wires show an excellence of finish. The Ideal wire has a black insulation with white fireproof outside finish, and is adapted for exposed wiring where a good white finish is desired.

THE HARTFORD MACHINE SCREW COMPANY. Hartford, Conn., has just issued a handsome and nicely bound catalogue and price list, in which are clearly and nicely presented its various types of automatic machinery and tools for turned metal work, simple in construction, readily understood and applicable to the greatest variety of work. One great advantage of the automatic machinery manufactured by this company is that it is not confined to special work, but may be used for other purposes than that for which it was designed. In the catalogue is also included the almost numberless screw and nut specialties which the company itself manufactures. The Hartford Machine Screw Company has always done a large business in the electrical field, and it is gratifying to note that it holds and increases it continually.

THE PARAGON ARC LAMP COMPANY, Boston, has just been organized, and its headquarters are located in the new Devonshire Building, 16 State Street. Its business will be confined principally to the manufacture of arc lamps of the enclosed high tension and low tension types, and it is possible that it will also introduce other electrical specialties. Mr. F. B. Smith, its manager, is well and favorably known to the electrical trade, having been Boston manager of the Perkins Electric Switch Manufacturing Company, and more recently engaged in arc lamp manufacture. The latter enterprise resulted in the formation of the Paragon Company. Mr. J. R. Hanmer, treasurer of the Paragon Company, is a wide-awake business man, and has been jointly interested with Mr. Smith for some time. Mr. H. E. Bradley, identified for years with arc-lamp manufacture, is the electrician of the company. The company introduces itself under most favorable auspices and has the best wishes of numerous friends and former patrons.

ANNUAL MEETING OF THE WEST END STREET RAILWAY COMPANY.—The ninth annual meeting of the West End Street Railway Company, of Boston, was held in that city on Nov. 24, and was of special importance on account of the struggle for control of the management of the road which was begun two months ago, and was carried on with increasing energy through the medium of communications to the stockholders from the conflicting interests. The so-called Morgan-Kidder-Peabody interest, which is composed of those holders of West End stock who are also interested in an elevated railway, was victorious at the election, as against the "Present Management", ticket. The Morgan party received 175,676 votes and the "Present Management" ticket 87,324. The "Present Management" party represented purely Boston interests, and now since the control of the road has passed into the hands of the Morgan syndicate, it is likely that radical changes in the policy and in the *personnel* of the company will be made. The tellers engaged in counting the ballots cast at the election were engaged on the work for over 24 consecutive hours. The chief point of difference between the old party and the new is that the new favors the elevated system. It was voted that the directors be authorized to issue 5 per cent. 20-year bonds under the authority of the railway commissioners. A long statement was read to the effect that the company has no permanent franchise or legislative authority as respect thoroughfares or rates of fares.

WESTERN NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, ILL., Nov. 27, 1896.

MR. F. S. TERRY, manager of the Chicago office of the Lakon Company, reports a steady increase in the number of orders for Lakon transformers since election, business at the present time being fully up to what it was a year ago.

THE CLEVELAND ELECTRIC CLUB.—The following named gentlemen have been elected officers of the Electric Club of Cleveland: C. W. Wason, president; E. P. Roberts, first vice-president; H. J. Davies, second vice-president; George W. Cleveland, secretary; E. W. Moore, treasurer. Board of Managers, Samuel Scoville, George M Hoag and the five officers above named.

THE WESTERN ELECTRIC COMPANY, Chicago, has been given the agency for the products of the Interior Conduit & Insulation Company, New York. All brass armored and iron armored conduits, elbows, couplings, fittings, etc., will be carried in stock in Chicago, and unusual facilities will be given to all jobbers and contractors for obtaining this material at the lowest prices. Coupled with this agency the Western Electric Company has also secured the agency for a fine line of standard iron armored, slate lined, panel, distributing, fuse, main and feeder terminals; also branch junction boxes. These boxes are specially designed and each box can be used on either two or three wire systems.

ST. LOUIS NOTES.

ST. LOUIS, Nov. 26, 1896.

THE BELLEVILLE ELECTRIC RAILWAY COMPANY was refused a franchise by the Mayor of East St. Louis.

THE FOURTH STREET & ARSENAL RAILWAY COMPANY is 6½ miles long and has a franchise of 50 years from 1893. The cable line (People's) is 9½ miles long and the Suburban line is about 30 miles long.

A NEW RAILWAY LINE.—Several wealthy manufacturers and capitalists are proposing to organize a stock company to operate a street car line running from the western suburbs of the city to a terminus on South Broadway.

THE BOARD OF PUBLIC IMPROVEMENTS intends to make it interesting for the companies supplying the city with arc lights, because of their failure to put up in a reasonable time all the lights ordered. Supervisor O'Reilly has submitted a report which shows that the city is short 279 lights, which ought to have been put up months ago.

THE FOURTH STREET CABLE and the Arsenal Street electric lines have several valuable franchises that have not been carried out, and when they are, in combination with the Suburban, there will be a complete system of ticket transfers, placing the people of the western, southern and northern portions of the city in direct communication for one fare.

MR. A. J. O'REILLY, supervisor of city lighting, has asked the electric railways to put in switches to their trolley wires at every crossing with another road. It will not be expensive, and the road will be benefited in case of a large fire along their lines. Some of the roads already have such crossing switches. The Lindell and Union Depot railways are well supplied.

THE SUBURBAN LINE has recently opened up some valuable extensions to the Webster Groves and Meremec, and beyond, and is now intending to take in Manchester in St. Louis County. They may also extend to the Meremec River, which is becoming a famous pleasure resort. The consolidation will mean the opening up of a great deal of territory in the southwestern section of the city.

THE CIRCUIT COURT last week denied the injunction asked by the People's Railway to restrain the Grand Avenue Railway from running its cars on Grand Avenue from Lafayette Avenue to Magnolia Avenue. It was alleged that the Grand Avenue Railway motor cars were so wide that the People's Railway cars were delayed in passing them. It was also alleged that the switches were in bad condition.

THE BOARD OF PUBLIC IMPROVEMENTS has decided to advertise for bids on three systems of public lighting instead of only one. These systems are the arc light, the incandescent light, and the combined arc and incandescent light. There has been such a fight made against the incandescent light only, which was recommended by President McMath, of the Lighting Committee, that this plan was decided upon. The decision to admit arc lights and the combined system to competition does not affect the other features of the specifications. The contract is for lighting the city for 20 years from 1900, and involves the expenditure of some $500,000.

CONSOLIDATION OF ST. LOUIS RAILWAYS.—It is rumored that there will be two big street railway consolidations consummated in St. Louis within a short time. One of the consolidations will be that of the Suburban street railway with the People's & Fourth and Arsenal Street railways. If the deal goes through, and there does not seem to be any doubt of it, as this

information comes from a very reliable source, the system will be one of the largest in the city. A Boston syndicate is reported to be interested with the local street car magnates, and will furnish the funds necessary to provide the system with the very latest and newest equipments. The other consolidation is reported to be that of the Southern Electric System with the Suburban, but the information comes from such a source that it cannot be verified.

THE BELL TELEPHONE COMPANY has plans for about 19 miles of conduits, 612,000 feet of ducts and 153,000,000 feet of wire, and Manager Durant estimates that it will cost his company $600,000 to go under ground. Most of the companies favor a vitrified clay conduit similar to that used in the East. The Western Union will probably use an ordinary 3½-inch iron pipe with special screw joints. Several knotty questions will have to be settled. One is how can the various obstacles now underground be surmounted? Another is that the plans for some of the conduits call for a trench seven feet deep, although a net-work of gas pipes is to be found in the down-town districts only two or three feet below the surface. About four feet down the water pipes will be encountered and the sewer pipes at five or six feet. The cable roads will also cause the wire using companies to dig under the cable trenches. The companies expect to begin work on the conduits by March 1, and to have them completed by mid-Summer.

BERTHOLD & JENNINGS, the well-known large contractors for street and steam railway equipment, telegraph, telephone and electric light poles, cross arms, etc., have recently moved their quarters to the Chemical Building on Olive Street, corner of Eighth, St Louis. This firm is well and favorably known in the building trade all over the West, and now intends to make a special feature of supplying poles for the various companies carrying aerial wire. For the last few years Berthold & Jennings have been furnishing white cedar poles in the Middle, West and Southern States in large quantities, and they have large stocks on hand at all times, and excellent facilities for quickly shipping the same in any quantity. The recent tornado in St. Louis destroyed upwards of 10,000 poles. To supply this extraordinary demand, Messrs. Berthold & Jennings, on the day following the tornado, loaded 16 cars with poles and delivered them in St. Louis on the third day. In 10 days after the tornado the firm had received in their yards in St. Louis upwards of 2000 long and large poles which were especially shipped to relieve the distress. The firm's supply depot being close to the Middle, Western and Southern trade, enables it to be particularly well equipped to supply all requirements with dispatch.

UNDERGROUND CONDUITS.—There are up to date, 14 applicants for permission to construct underground conduits in accordance with the terms and provisions of the Keyes subway bill that passed the City Council a short time ago. The full list of applicants includes the Electric Light & Power Company of St. Louis; Missouri Electric Light & Power Company; Edison Illuminating Company of St. Louis; Trans Mississippi Electric Company; St. Louis Electric Light & Power Company; Western Union Telegraph Company; Samuel Cuppers; Phœnix Light, Heat & Power Company; American Telephone & Telegraph Company of Missouri; Bell Telephone Company of Missouri; Citizens' Electric Light & Power Company; Edison Illuminating Company of Carondalet; Laclede Power Company, of St. Louis, and Telephone & Telegraph Service Company. Several of the applications have been pronounced irregular by the municipal authorities, but the applicants have until Dec. 7 to perfect them. The companies using the wires must each file a $5000 bond with the City Register, approved by the Mayor and the Council, and must deposit with the Board of Public Improvements $25 for each 75 feet of street it intends to tear up, as a guarantee that it will restore the street to its original condition.

Pacific Coast Notes.

San Francisco, Cal., Nov. 21, 1896.

MR. HARVEY L. LUFKIN, manager of the Crocker & Wheeler Electric Company, New York, is in the city on business.

THE CITY & SUBURBAN RAILWAY COMPANY, of Portland, Ore., has substituted electricity for steam motors on its Mount Tabor branch line.

PROPOSED ELECTRIC LIGHT PLANT.—Six per cent. bonds to the amount of $18,000 are to be sold by Anaheim, Cal., to supply funds for the electric light system and water-works.

MUNICIPAL PLANT IN SEATTLE.—It is reported that the City of Seattle, Wash., will probably establish a city electric lighting plant if the Cedar River transmission plant is constructed.

CHANGED TO ELECTRIC POWER.—The Main Street & Agricultural Park Railway, of Los Angeles, Cal., is being transformed into an electric line. Westinghouse equipments have been ordered.

OLD CAR TRACKS.—Non-used street railroad tracks, of which there are many miles in this city, are receiving attention from the Grand Jury of San Francisco County. The old rails remain upon the routes of many abandoned horse-car lines, and the City and County Attorney has advised the jury that judicial proceedings would be necessary to compel the companies interested to remove the obstructions.

TRANSMISSION PLANT.—The Redlands (Cal.) Electric Light & Power Company commenced operating its new transmission line to Riverside and Colton on Nov. 3. The distance to Riverside is 21 miles. General Electric alternating apparatus is used at a potential of 3000 volts. After stepping up to 10,000 volts the voltage is reduced at the sub-station to 2000 and again to 100 volts. Wagner transformers are to be used. The California Electrical Works of this city were sub-contractors on pole line and wiring for the long distance transmission line.

LARGE ELECTRIC POWER PLANT.—The California Exploration Company, in which Prince Poniatowski is largely interested, is doing a large amount of development work in Calaveras County. Two hundred men are at work excavating for the foundations of the electric power station at Big Bar Bridge. The head of the water obtainable is estimated at 1043 feet. Twelve mining properties are being prepared for exploration. One of the two tunnels to be run at Mokelumne Hill is 1300 feet in length, and will be equipped with electric apparatus for hauling gravel to the mill. Electric pumps and sinking plants will be used in places.

THE MARKET STREET RAILWAY COMPANY, of this city, has decided to convert several more of its cable-car lines into electric lines. It is supposed that the work will be commenced early next year. It is also the intention of the company to change the cable power-house at the corner of Washington and Mason Streets to an electric power station. Among the lines that will be changed over to electric lines are the Post, Leavenworth, Howard, Sacramento, Clay, Jackson and Powell Street cable lines and the horse-car line on Montgomery Street. As four of these lines have to overcome very heavy grades, it is probable that much of the counter-balance system, such as is used on Fillmore Street, will be required.

ELECTRIC MAIL CARS.—The electric and cable car mail service upon the lines of the Market Street Railway, in this city, has proven so efficient that it has been extended to two additional sub-stations—one at Mission and Twenty-fourth Streets and the other at Seventeenth and Castro Streets. Passenger cars have been temporarily used for the increased service, as there are not enough mail cars at present. Placards bearing the words "U. S. Mail Car," in large letters, are placed temporarily on the front of a passenger car, when mail has to be taken to the ferries to catch a train without interfering with the time schedule of the regular electric mail car. A fine of $300 is to be imposed upon any teamster, or other person, who may delay a mail car by obstructing the track.

Canadian Notes.

Montreal, Can., Nov. 28, 1896.

TORONTO, ONT.—The Metropolitan Street Railway will probably be extended to Lake Simcoe, in which case an additional power-house will be erected at New Market or Surora.

WINNIPEG, MAN.—The City Council, after dallying all the year, is remarkably active just now. The Aldermen have just passed a by-law to spend $350,000 for an electric and gas-lighting plant.

ST. LOUIS DU MILE END, QUE.—The town of St. Louis du Mile End has taken an action against the Park & Island Railway to annul the contract to supply an electric car service in the municipality. The Corporation of the town claims that the company has failed to keep its engagements to supply as good a service as in Montreal and to give transfer tickets.

MONTREAL.—The municipality of St. Louis du Mile End has awarded the Citizens' Light & Power Company the contract for lighting the streets for the next 13 years. The company was also awarded an exclusive franchise for lighting private residences for the same space of time. A company has been organized with $150,000 capital, with headquarters in this city, for the purpose of manufacturing horseless carriages. The motive power will be petroleum and electricity. The tires will be of solid rubber.

CONTRACTS AWARDED.—The Lachine Rapids Hydraulic & Land Company, Montreal, has awarded two contracts in connection with the fitting out of its plant, one to the National Underground Cable Company, New York, and the other to the Wagner Manufacturing Company, St. Louis. The former company's contract will amount to some $50,000, and is for electric cables. The latter company has the contract for transformers required for reducing the voltage. They will cost between $8000 and $10,000.

DUTY ON RAILS.—The Treasury Board, Ottawa, has now under consideration the applications of the several street railway companies in the Dominion for a refund of duties paid upon steel rails. The departmental ruling was that the street railways being tramways were not entitled to import their rails free of duty, and the companies were accordingly taxed the full 30 per cent. A recent decision of the Judicial Committee of the Imperial Privy Council settled the dispute in favor of the contention of the street railway companies, whose claims for a refund are now before the Government. There are about half a dozen such claims, amounting in all to something under $200,000, the largest being those of the Toronto Street Railway for $70,000, and the Montreal Street Railway for $65,000.

ELECTRIC LIGHT INSPECTION.—The Commissioner of Inland Revenue in his report to the Government, says the provisions of the Electric Light Inspection Act have been put into operation in the provinces of Ontario, Quebec, New Brunswick, Nova Scotia and Prince Edward Island. Offices for testing electric light meters, etc., have been fitted up with the necessary apparatus at the following places: Windsor, London, Hamilton, Toronto, Belleville, Ottawa, Montreal, Sherbrooke, Quebec, St. John and Halifax. In each place the gas inspector has been appointed electric light inspector, and instructed in the use of the testing apparatus. Taking into account the difficult nature of the work, and the fact that it was entirely new to them, it may be said that the inspectors, during this their first year, have acquitted themselves very creditably indeed. A set of Lord Kelvin's absolute standard apparatus, both for the measurement of current and potential, are now being placed in position in the standards branch at Ottawa. The total revenue collected during the year for registration and inspection of meters was $8,681 25, total expenditure, $6,693.23.

English Notes.

(From Our Own Correspondent.)

London, Nov. 11, 1896.

ROYAL SOCIETY MEDALS.—The Romford medal of the Royal Society has been awarded to Profs. Lenard and Röntgen. The Davy medal has been awarded to M. Henri Moissan, and a Royal medal has been awarded to Mr. C. V. Boys for his invention of quartz fibres.

FIRE INSURANCE OF ELECTRIC LIGHTING STATIONS.—The movement in favor of forming a mutual insurance concern for the fire insurance of electric lighting stations is gaining force and unless the companies lower their rates some such company will undoubtedly come into existence, or the central station owners will self-insure themselves.

MOTOR CARS.—The motor car trip from London to Brighton took place on Saturday last in the worst possible weather. But in spite of a dense fog and muddy roads an immense crowd gathered to see the start, and some half dozen out of the large number of cars that started from London at 10.30 found their way into Brighton, some 60 miles distant, at about 6 o'clock, two of the arrivals being electrical.

"APPROVED" ELECTRIC METERS.—Meters in this country have to receive the approval of the Board of Trade. Up till quite recently no meter has received more than "provisional" approval. The London *Gazette* of Oct. 30 however announces that a full approval has been given to the Hookham and Ferranti meters for the purpose of "the measurement of electrical quantity when supplied on the constant potential continuous current system."

ELECTRIC TRACTION.—The British Electric Traction Company, with a capital of £600,000, came before the public to-day with a request for half that amount. Under the name of the British Electric Traction (Pioneer) Company this well managed concern has for some time past been quietly but quickly acquiring electric traction rights in various parts of the country, and now propose to put these into force. I hear, on good authority, that the schemes which it has negotiated will quickly absorb the £300,000 now asked for, and that a further call will soon be made upon the public. We are going right ahead in this country at last in this matter of electric traction.

ELECTRICAL CABS FOR LONDON.—At the beginning of the present week subscriptions to the extent of £100,000 were asked for the London Electrical Cab Company, Limited, having a share capital of £150,000. This company has been, according to the prospectus, formed to place upon the streets of London electrically propelled cabs. The form of cab which it controls is said to be covered by the patents of a Mr. Walter C. Bersey. For the privilege of using this cab and other patent contrivances of the British Motor Syndicate, the new company has to pay a royalty of £4 per cab per annum to the Syndicate, and a lump sum of £50,000 in cash or shares. The public is informed that the Great Horseless Carriage Company graciously concurs in this arrangement, and will be good enough to manufacture the cabs for the company. The price has been fixed by means of an intermediary known as the Traffic Syndicate, Limited. One would scarcely have thought that so many hands were necessary to launch this comparatively small ship. It is proposed to start with some 300 cabs, there being at present 10,000 licensed cabs in London. Each cab will be provided with two sets of accumulators per diem, capable of propelling the vehicle 40 miles with one charge. Depots will be opened in different parts of London, so that the driver, instead of driving to the nearest mews for a new horse, will merely drive to the nearest charging station and procure a second set of accumulators. Messrs. Kincaid, Waller & Manville, the well-known consulting electrical engineers, state that they are of opinion that the proposed cab is thoroughly adapted to meet the requirements of London traffic, and they estimate that one half a kilowatt-hour will be sufficient to propel one of these cabs one mile. It is intimated that the various electric lighting companies are willing to co-operate in the matter of charging the batteries of this concern.

General News.

NEW INCORPORATIONS.

THE CASWELL ELECTRIC COMPANY, Portland, Me., has been formed by W. H. C. Rowe, Winchester, Mass., Byron C. Caswell and T. E. Eaton, of Boston, Mass. Capital stock, $150,000.

THE TRANS-MISSISSIPPI ELECTRIC COMPANY has been organized at St. Louis, Mo., by E. P. Cowen, of Kansas City, Edward J. Stiles and U. S. McMullen. The capital stock is $2,000.

THE SNOW MANUFACTURING COMPANY has been incorporated at St. Louis, Mo., with a capital stock of $20,000. The incorporators are J. R. Kendall, Henry L. Snow and Fred Suessdorf.

THE CUPPLES STATION LIGHT, HEAT & POWER COMPANY, St. Louis, Mo., has been incorporated with a capital stock of $5,000. The incorporators are Samuel Cupples, R. S. Brookings and Edward S. Pierce, St. Louis.

THE ELECTRIC PUSH-BUTTON MANUFACTURING COMPANY has been incorporated at St. Louis, Mo., with a capital stock of $50,000. Those interested are Anthony Silverston, William Y. Hopkins and C. M. Napton.

THE CHICAGO & DESPLAINES VALLEY STREET RAILWAY COMPANY has been incorporated at Chicago, Ill., with a capital stock of $100,000. Those interested are Frank Lehmann, Otto Gorke and Robert E. Williams.

THE MOTHER LODE ELECTRIC POWER COMPANY, San Francisco, Cal., has been organized with a capital stock of $200,000. Those interested are John C. Jens, Alexander Woodside, Theodore Frolich, G. Gale, San Francisco, Cal., and W. J. Woodside, Belfast, Ireland.

THE PITTSBURG, WIER & COLUMBUS RAILWAY COMPANY has been organized at Pittsburg, Kan., with a capital stock of $200,000. The incorporators are Robert Simons, Westchester, Pa.; John A. Nuttman, J. M. Liepman, John Randolph and Samuel Barratt, Pittsburg, Kan.

THE MARSHFIELD & LOYAL TELEPHONE COMPANY has been organized in Marshfield, Wis., for the purpose of building a telephone line from Loyal to Marshfield, a distance of 17 miles. The names of those interested are J. C. Marsh, of Spokeville; Edward Schultz, of Veefkind; W. B. McPherson, of Veefkind, and A. A. Graves, of Loyal.

TELEGRAPH AND TELEPHONE.

DEFIANCE, O.—The Northwestern Telephone Company has completed its new line connecting Toledo with Defiance. The circuit includes Wauseon, Napoleon, Florida, Jewell and Liberty Centre.

BRITT, IA.—The Western Electric Telephone Company, which has its main office in this place, has lately completed its lines to Sioux Falls and Canton, S. D., and also to Luverne, Minn. The company is now pushing construction work in the direction of Pipestone. This company, it is stated, is one of the largest and most successful of the independent toll line companies in the West and for this reason considerable interest attaches to its development. The company is now operating nearly 2000 miles of toll lines and its plant is being rapidly extended.

ST. LOUIS, MO.—An effort is being made to accomplish the unification of all the electrical companies interested in the construction of the underground conduits in this city. Under the present arrangement the companies would build separate conduits under separate contracts. The plan suggested is to have the conduits built as one system under one general management, and all the work in the same street done under one contract. A meeting of the representatives of the various interests will be held to consider the proposition and take necessary action in the premises.

STATE SUPERVISION OF THE TELEGRAPH AND TELEPHONE.—Assemblyman-elect Henry E. Abell, it is stated, proposes when he gets to Albany to introduce a measure having for its object the establishment of a Telephone and Telegraph Department, with a State superintendent and State inspectors, to supervise the telephone and telegraph companies in a manner similar to the system now in vogue of supervising banks and insurance companies. Mr. Abell thinks that such a bill would have a salutary effect. The complaints which are presented to the Legislature from time to time of telegraph and telephone companies' methods, he thinks, could be satisfactorily adjusted if there were a State department conducted after the manner of the Department of Insurance.

ELECTRIC LIGHT AND POWER.

NEW ROCHELLE, N. Y.—A special meeting of the Board of Village Trustees will be held to consider the question of electric lighting.

EGG HARBOR CITY, N. J.—Egg Harbor City Council granted a franchise for the erection of an electric light and power plant to Green & Siggons, Philadelphia.

BALDWIN, N. Y.—The women of this place have taken up the matter of providing Baldwin with street lights. Mrs. E. Mack and others are interested and can give information.

WESTMINSTER, MD.—The Cumberland Ice Company, it is said, will shortly add to its present plant a complete electric light equipment. The company will compete for street and house illumination.

MANCHESTER, CONN.—It is stated that the Mather Electric Company's factory has been leased to an English syndicate, and that work will begin shortly on the construction of a power road carriage.

HASTINGS, MINN.—The electric light plant in this place was destroyed by fire a few days ago, entailing a loss of $25,000. The building contained two boilers, two engines, two dynamos, and all the usual accessories.

MILLVILLE, N. J.—Proposals will be received until 8 p. m., Dec. 23, for the exclusive franchise for supplying the City of Millville, N. J., with 100 or more arc lamps for a term of five years. T. C. Wheaton is chairman of committee.

NEW ROCHELLE, N. Y.—In the matter of the franchise of the Larchmont Electric Company, the village trustees, at their meeting, voted unanimously to grant the petition. The work of erecting the poles and equipment will be begun at once.

PARKERSBURG, W. VA.—The improvements which will be commenced at the electric light plant will result in making the capacity of the plant just twice as large as it is at present. The entire arc plant will be duplicated. The total cost of these extensive improvements will be about $10,000.

GRAND FORKS, N. D.—A new electric light company has been organized. The buying of a gas plant is the first step and it is understood than an electric light plant will be added at once with the intention of securing if possible the contract for furnishing the city with sufficient arc light to light the city.

PLANT SOLD AT AUCTION.—On Nov. 17 the plant and franchise of the Consolidated Gas & Electric Company of Westchester County were sold at auction for $190,202, under foreclosure. The purchaser was Charles Perry, of Westerly, R. I., who represented the first mortgage bondholders. The company supplied Portchester, Rye, Mamaroneck, Harrison, Larchmont and a portion of Greenwich, Conn.

NEWPORT, R. I.—The Appellate Court on Nov. 21 rendered a decision in the two cases brought against the tax assessors of Newport by the Newport Illuminating Company to recover portions of taxes paid by the company in 1894 and 1895. The company claimed that certain property has been classed as real estate by the assessors which was in reality personal property and that it had been overtaxed. The court sustained the company in both cases, which were based on identically the same points.

THE ELECTRIC RAILWAY.

JERSEY CITY, N. J.—The Consolidated Traction Company is considering numerous extensions of its lines in different parts of the State.

CHICAGO, ILL.—The stockholders of the South Chicago City Railway authorized an increase of capital stock from $1,500,000 to $2,000,000.

NORWAY, ME.—The talked of electric road between Norway and North Waterford is again being agitated. The distance is about 13 miles.

BUFFALO, N. Y.—The Supervisors have granted to the Buffalo Traction Company permission to string wires and lay tracks in Franklin Street, between Eagle and Church Streets.

NEW HAVEN, CONN.—The New Haven Street Railway Company has prepared a petition to the State Legislature for an extension of its lines to Cosy Beach, a Summer resort of East Haven.

EAST BERLIN, CONN.—T. W. Platt and Engineer Cadwell, of the Central Electric Railway, were in town, and it is probable that their line will be extended to East Berlin in the near future.

LORAIN, O.—The new Cleveland & Lorain electric line will erect its $30,000 power house on the Smith farm, seven miles east of this city. The structure will be of the very latest design.

ARLINGTON, N. J.—The Consolidated Traction Company, Newark, has made application to the committee for permission to extend its present line up Kearney Avenue to the Belleville Turnpike.

PUNXSUTAWNEY, PA.—The construction of a trolley road between Punxsutawney and Indiana is contemplated. Samuel A. Chase, a representative of the Western Electric Company, it is stated, is interested.

ALBANY, N. Y.—The Albany, Helderberg & Schoharie Electric Railway Company has voted to increase the capital stock from $300,000 to $500,000 and to run a road direct from Albany to Schoharie, a distance of 40 miles.

PATERSON, N. J.—The Consolidated Traction Company, it is stated, is about to complete a deal whereby it will absorb the Passaic & Newark electric railway, and will realize its scheme of running a through line from Newark to Paterson.

BENNINGTON, VT.—It is believed that work on the Bennington Electric Railroad, a charter for which was obtained two years ago, will be commenced next Spring. The road will be nine miles long, and will connect at Walloomsac with the Hoosack Falls Road.

BINGHAMTON, N. Y.—The Binghamton Street Railway Company proposes to connect the Ross Park and Port Dickinson lines, making a continuous trip from that village to the park. The work of laying the double track will be commenced as soon as possible.

EASTON, PA.—A recent decree of the Northampton County Court provides that the Lehigh Valley Traction Company must pay the license on cars and poles imposed by the various municipalities through which the lines run. This case has been in court for three years.

LARCHMONT, N. Y.—It is reported on good authority that Charles Singer, who owns the horse railway at Larchmont, intends, with the co-operation of other New York millionaires, to construct a trolley road in place of the present system, and that it will be in operation before next Spring.

PATCHOGUE, L. I.—The trustees of this village have denied the application made by the Patchogue & Port Jefferson Traction Company for a franchise to build and operate its cross-island trolley road on Ocean Avenue and North Ocean Avenue. The ground upon which the refusal is based is that the consents were defective.

LYONS, N. Y.—Several residents of Wayne County are taking an active interest in the proposed building of a trolley line from Clyde to Palmyra. The new road will probably take in the towns of Walcott and Savannah. It is stated that the enterprise now has $100,000 available, and that the sum will be largely increased as soon as the charter is secured.

NEW ORLEANS, LA.—The New Orleans Traction Company has completed arrangements for the building and equipment of a separate plant for the purpose of furnishing power for the operation of the street railways owned by the company. The plant, it is stated, will be completed within three months and will be furnished with reserve engines, boilers and generators.

BROOKLYN, N. Y.—The commissioners, who have been considering plans for the improvement of Atlantic Avenue, have abandoned the idea of depressing the tracks of the Long Island Railway on account of the great expense involved in such an undertaking. They will, however, probably recommend in their report to the Legislature that electric power be substituted for steam on the lines.

NEW HAVEN, CONN.—A town meeting has been called of citizens of Vernon, Conn., which contains the City of Rockville, to vote upon the question of allowing the Hartford, Manchester & Rockville Trolley Company to extend its line to the latter city from Talcottville. The proposed line will parallel the Vernon branch of the New England Company and complete a trolley parallel between Hartford and Rockville.

CINCINNATI, O.—The Cincinnati, Hamilton & Dayton Railway Company has just obtained possession of the street railway lines in Middletown, O. It is proposed to connect the street car tracks with those of the steam line and run through electric cars from Middletown to Hamilton. It is stated that the company will extend the electric service as rapidly as circumstances will permit, and it is likely that eventually Cincinnati will be connected with Middletown by the electric line.

Personal Notes.

MR. SAMUEL A. DUNCAN, well known to a great many electrical people throughout the United States, was recently appointed to the position of inspector and auditor of the Postal Telegraph Company for the United States. Mr. Duncan was one of the chief promoters of the National Electric Light Association, and was its second president. In recent years he has been particularly interested in the telephone industry in Pittsburg, where he resides.

MR. C. E. WOODS, the well-known designer of dynamo-electric machinery, at one time chief electrician and designer for the Standard Electric Company, Chicago, and inventor and designer of the electric vehicles produced by the American Electric Vehicle Company, Chicago, has severed his connection with the latter company, and pooled issues with the Northern Electrical Manufacturing Company, Madison, Wis., as its engineer-in-chief, for whom he is developing a large line of motors and generators.

Obituary Note.

PROF. BENJAMIN APTHORP GOULD, the distinguished astronomer who died at his home in Cambridge, Mass., Nov. 26, at the age of 72, devoted much attention to the application of electricity in astronomical work. He was among the first to use electricity for the purpose of determining the differences of longitude and recording by telegraph the exchange of signals and stellar observations. Hardly was the transatlantic cable laid before Prof. Gould started for Valentia, Ireland, and there established the station from which the difference of longitude between Europe and America was determined, and connected the two continents by the most precise observations. Prof. Gould also organized the Dudley Observatory at Albany, N. Y., and it was his clock which gave the time signals to New York.

Trade and Industrial Notes.

THOS. C. WARLEY & CO., 11 South Ninth Street, Philadelphia, finding the demand for their boiler cleansing compounds and lubricating oils and greases growing beyond their facilities for supplying the trade, have concluded to double the capacity of their plant. These additions will enable them to keep up with the demands of the trade.

THE DAVIS & EGAN MACHINE TOOL COMPANY, of Cincinnati, reports a great improvement in trade since the election. During the past 10 days it has taken some large orders from bicycle factories, electrical manufacturers, brass shops, founders, machinists. paper mills, etc , showing the improvement to be general and not in any particular line.

METROPOLITAN OIL FILTER.—The Metropolitan Electric Company, 186 and 188 Fifth Avenue, Chicago, is pushing very successfully its pneumatic pressure filter, which it claims to be "the best oil filter in the market." The oil to be filtered is forced through a filtering diaphragm by air pressure and the cleansed lubricant is received in a tank whence it may be withdrawn for use as desired. It is said to be a practical device.

NATIONAL ASSOCIATION OF MANUFACTURERS.—The second annual convention of the National Association of Manufacturers will be held in Philadelphia, on Jan. 26, 27 and 28, 1897. It is expected that this convention will be one of unusual interest, as the president will submit a report of the first full year of practical work. Hon. Charles A. Schieren, of Brooklyn, is a member-at-large of the Executive Committee.

THE AMERICAN SILK MANUFACTURING CO., 311 Walnut Street, Philadelphia, reports a very large business, and have recently increased its facilities to meet this growth of trade. Superintendents and others say that raw silk wipers for machinery, and especially for electrical purposes, are much superior to cotton waste, which is being rapidly relegated to the rear since the Board of Fire Underwriters endorsed the use of silk wipers.

THE ELECTRIC ENGINEERING & SUPPLY COMPANY, Syracuse, N. Y., has in preparation a very complete catalogue of the articles manufactured by it. The list includes railway material, line material, hoods, a complete line of incandescent supplies, and a very extensive display and price lists of jack knife switches. A special feature of the catalogue will be illustrations and prices of all switch parts and switchboard parts.

PLATINUM.—C. F. Croselmire, 251-253 New Jersey Railroad Avenue, Newark, N. J., makes a specialty of preparing platinum in any form for the electrical trade. Mr. Croselmire keeps this metal in sheet or wire and of any size and degree of hardness. He has the latest improved machinery for the manufacture of wire, etc., especially that used in incandescent lamps, and he carries in stock wire from .001 of an inch in diameter and upward.

THE BERLIN IRON BRIDGE COMPANY.—Among the numerous contracts which the Berlin Iron Bridge Company has secured of late for steel roofs covered with corrugated iron, lined with its patent anti-condensation roof lining, is the roof for the new power station for the Stamford Gas & Electric Company, at Stamford, Conn. The lay-out of this station is very convenient, and the construction is to be the very best. The engine and the dynamo-room is 60 feet wide and 100 feet long, and the boiler-room adjoining is 40 feet wide and 75 feet long. The walls are of brick, and the framework of the roof as well as the supports for the traveling crane in the engine and dynamo room are of steel. The Berlin Company has the contract for furnishing and erecting all of the structural steel work.

THE GENERAL ELECTRIC COMPANY has brought five suits against the Fiberite Company, Mechanicville, N. Y., manufacturers of the Medbery insulation and overhead trolley equipment, for alleged infringement of patents on "suspension devices and ears" for trolley roads. These suits will be watched with interest by electric roads not using General Electric equipment, and by manufacturers of overhead devices. If the General Electric Company can establish the validity of these patents, Mr. Medbery says it means that manufacturers of overhead devices may go out of business, and such railways as use other overhead equipment may be compelled to "settle up" with the General Electric for all past offenses, and arrange for future uses of such equipment. The Fiberite Company proposes to defend this suit vigorously and has employed some eminent patent lawyers to contest the case.

Business Notices.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 67-71 Park Place, New York.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, 105 South Warren Street, Syracuse, N. Y.

GRAND CENTRAL STATION, NEW YORK.—Entering or leaving New York by the New York Central, the traveler will appreciate the convenience of Grand Central Station, Fourth Avenue and Forty-second Street, which is in the very centre of the hotel, residence and theatre district, and the point from which all principal lines of elevated and surface cars radiate. The New York Central is the only Trunk Line whose trains enter the City of New York.

HOME SEEKERS' EXCURSION.—On Nov. 17 and Dec. 1 and 15, 1896, the Chicago, Milwaukee & St. Paul Railway will sell round trip excursion tickets from Chicago to a great many points in the Western and Southwestern States, both on its own line and elsewhere, at greatly reduced rates. Details as to rates, routes, etc., may be obtained on application to any coupon ticket agent, or by addressing E. F. Richardson, general agent passenger department, New York City.

"FOUR-TRACK SERIES" ETCHINGS.—Eight beautiful etchings, representing scenery along the line of the New York Central, printed from steel

plates on plate paper, 24 by 32 inches, are offered for sale at the office of George H. Daniels, general passenger agent, Grand Central Station, New York, at 50 cents each. Art lovers will appreciate this opportunity to secure at nominal cost pictures of high artistic merit, devoid of any objectionable advertising feature and suitable to hang on the wall of any room.

"AMERICA'S GREATEST RAILROAD."—The traveler who enters a New York Central train at Grand Central Station, and keeps his eyes open, as he speeds out across the Harlem, and along the banks of the noble Hudson, and is whirled away toward the West cannot fail to be impressed, first, with the comfort and elegance of his surroundings; second, with the grandeur of the scenery viewed from the car windows, and, finally with the physical superiority of a railroad that can run hundreds of miles without a jolt or jar, and on so exact a schedule that it is said the officials of a town in Western New York have for years set their watches every day by the time of a certain train.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOV. 24, 1896.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

11,576. INDUCTOR DYNAMO; C. P. Steinmetz, Schenectady, N. Y. App. for re-issue filed Oct 31, 1896. An inductor dynamo having inwardly projecting pole pieces provided with field magnet windings, armature-coils mounted upon the polar faces, and a revolving inductor. (Re-issue.)

571,738. ELECTRIC STREET OR STATION INDICATOR; H. Alwies, St. Louis, Mo. App. filed Aug. 10, 1896. In an electric indicator, a line wire, a suitable web on which the names of the stations are disposed, rollers for said web, a series of circuit-closing devices disposed in proximity to the line wire along the length thereof, a motor for advancing the web or turning the rollers on which the same winds, suitable mechanism actuated by the closing of the circuit under the action of the circuit-closing devices, for arresting the momentum of the web and rollers carrying the same acquired during the advancing movement of the web, and intermediate connections between the momentum-arresting device and the motor for alternately closing and breaking the circuit by which the motor is actuated.

571,739. ELECTROMAGNETIC SENTINEL; F. B. Badt, Chicago, Ill. App. filed Feb. 15, 1896. In a signal device, the combination with a coil having its core in open magnetic circuit, of a source of alternating or interrupted current passing through the said coil, and an indicator provided within the circuit of the said coil adapted to indicate any current variation therethrough.

571,760. MEANS FOR INSULATING ELECTRIC CONDUCTORS; T. Guilleaume, Mulhein-on-the-Rhine, Germany. App. filed Nov. 2, 1895. In an electric cable, a duplex tube produced from a single strip of non-conducting material, the edges of the strip being turned inward, and constituting or forming part of a central partition dividing the tube into two compartments, the tube being moreover twisted about its axis so as to form spiral air-spaces within which the conductors are enclosed.

571,769. ELECTRICAL IGNITING DEVICE FOR GAS BURNERS; G. F. Kreiger, Kiel, Germany. App. filed May 4, 1896. An electrical igniting attachment for gas burners consisting of a clip or strap adapted to be secured to the burner, a spring and a two-armed rock lever, respectively secured to and pivoted on said strap, one of the arms of said lever provided with a suitable contact adapted to impinge upon the spring and flex the same and having its other arm constructed telescopically and adapted for connection with the plug of a gas-cock.

571,780. DYNAMO-ELECTRIC MACHINE; W. F. Marzahn, Buffalo, N. Y. App. filed Sept. 21, 1896. In a dynamo-electric machine the combination of a drum armature with ventilating tubes disposed in the ends thereof.

571,791. SWITCH FOR ELECTRIC LAMPS; H. R. Quinby, Rochester, N. Y. App. filed Dec. 4, 1895. In an electric-lamp switch, the combination with the lamp-board and hanger-board, of yokes pivoted to the hanger-board so as to turn up and down; springs for forcing the yokes upward; contact-pins resting in line with the yokes and against which the yokes strike; and open-hooks attached to the lamp-board and engaging with the yokes and drawing them down from contact with the pins.

571,792. ELECTRIC ARC LAMP; H. R. Quinby, Rochester, N. Y. App. filed March 12, 1896. In an electric lamp, the combination of a tubular magnet, a cylindrical armature resting therein and provided with a central passage of greater diameter than the carbon so that the carbon will not come in contact with the armature, a set of non-conducting balls resting in inclines in the armature, clamping the carbon, a stop below the balls entering the end of the armature and raising the balls when the armature is lowered, a cap below the armature and insulated therefrom, and a set of conducting balls resting on slight inclines in the cap and bearing against the carbon, the whole so arranged that the two sets of balls centre the carbon and hold it from contact with the magnet, and the lower set of balls serve as conductors to convey the current to the carbon at its lower end, thereby preventing any circuit between the carbon and the armature above the lower set of balls.

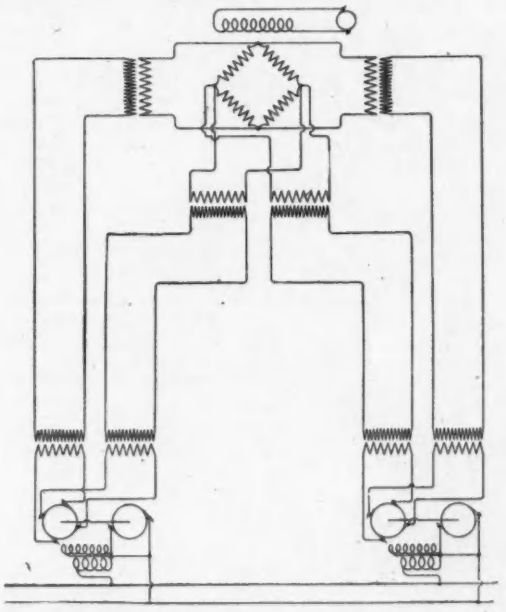
571,832. ELECTRICAL RAILWAY; R. M. Hunter, Philadelphia, Pa. App. filed Feb. 17, 1896. In an electric railway, the combination of a slotted conduit extending along the railway, a bared conductor arranged within the conduit and insulated from it, an electrically propelled car, a current-collecting device extending from the car down through the slot into the conduit, making an electrical contact with the bared conductor and also having wheels resting and running upon the conduit at the top, a laterally adjustable connection between the axle and collecting device for sustaining the conductor in an upright position and positively moving along the conductor independently of the vertical movements of the car-body, and a return circuit from the car to the source of electric supply.

571,836. SYSTEM OF ALTERNATING-CURRENT REGULATION AND DISTRIBUTION; B. G. Lamme, Pittsburg, Pa. App. filed April 6, 1896. A system of electrical distribution comprising an alternating-current generator, feeders supplied thereby, a direct-current circuit and a rotary transformer having a single compound-wound field-magnet and an armature located in the resultant field produced by said compound winding and connected to said alternating-current and direct-current circuits.

571,839. STATION POTENTIAL INDICATOR; R. D Mershon, Pittsburg, Pa. App. filed Dec. 23, 1895. A station potential indicator for alternating current systems, comprising a local circuit in which the impressed and counter E. M. Fs. of the main line are approximately reproduced in miniature, and a voltmeter for indicating the value of the resultant of these E. M. Fs.

571,849. SYSTEM OF ELECTRICAL DISTRIBUTION; O. B. Shallenberger, Rochester, Pa. App. filed Nov. 8, 1886. The combination of a main line, a converter having its primary included in the main line, conductors leading from different points in the length of the secondary coil, translating devices or groups of the same, and a circuit controller for including said translating devices or groups of the same between different conductors leading from the secondary coil at will.

571,863. ROTARY TRANSFORMER REGULATION; R. D. Mershon, Pittsburg, Pa. App. filed April 6, 1896. The method of controlling the E. M. F. delivered from the direct current end of a rotary transformer in accordance with the changes in load, which consists in compounding the field of such transformer and establishing a difference of voltage between the same and the generator, which difference decreases as the load upon the direct-current side increases.



No. 571,836.—SYSTEM OF ALTERNATING-CURRENT REGULATION AND DISTRIBUTION.

571,888. ELECTRIC RAIL BOND; G. H. Scott, Worcester, Mass. App. filed April 23, 1896. An electrical rail bond, comprising in combination a connecting rod and collars adapted to fit over the ends of said connecting rod and in the rail-flange openings, said collars being tapered or conical-shaped upon the outside, and their longitudinal openings cylindrical in shape about half way through from the smallest to the largest ends of the collars, and flaring outward tunnel-shaped therefrom, to the larger ends of said collars.

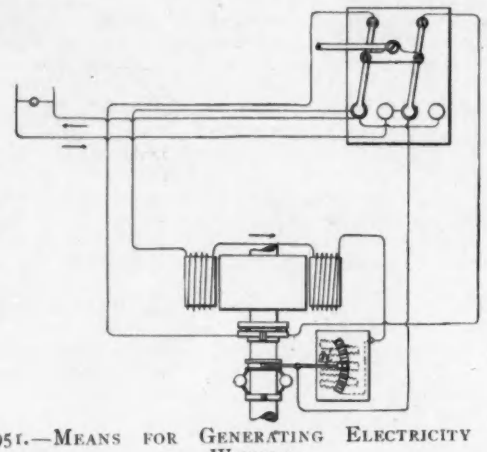
571,906. APPARATUS FOR MULTIPLE SWITCHBOARDS FOR TELEPHONE EXCHANGES; C. E. Scribner, Chicago, Ill. App. filed Feb. 7, 1893. The combination with several pairs of connecting pairs of connecting-plugs, of conductors joining the different members of each pair, branches connecting each of said conductors with one terminal of an operator's telephone, and retardation coils included in said branches.

571,907. TELEPHONE; C. E. Scribner, Chicago, Ill. App. filed Feb. 7, 1893. The combination with the electromagnet of a telephone receiver, of an electromagnetic coil not one of the telephone coils, and circuits connecting the telephone receiver and the said electromagnetic coil in different parallel branches of a line circuit, and a source of electricity in one of said branches, whereby the battery and telephone coil are included in a local circuit and the passage of telephonic currents through the battery is prevented by the impedance coil.

571,910. TELEPHONE EXCHANGE SYSTEM; C. E. Scribner, Chicago, Ill. App. filed Oct. 16, 1894. The combination with a telephone line provided with means for transmitting alternating signalling currents, of a line annunciator in a bridge therefrom adapted to display its indicator when excited by alternating currents, but to conceal the same when traversed by continuous currents, a plug for making connection with the line, a clearing-out annunciator adapted to respond to alternating currents, and means for

preventing the actuation thereof by continuous currents, said clearing-out annunciator being connected with the plug, a source of continuous current, and means for connecting said source of current with the conductor of the telephone line to find circuit through the line annunciator when connection is made with the line.

571,927. ELECTRIC SWITCH; J. T. Norton, Boston, Mass. App. filed Jan. 28, 1896. In an electric switch, a switch member, an actuator having a rocking and a lateral movement, a wiper thereon provided with an abutment, independent plungers to rock said actuator in opposite directions, and a movable resilient switch member adapted to engage the abutment at one or the other side, to thereby move the actuator laterally after passing its dead centre, inward movement of the switch-closing plunger rocking the actuator to cause the wiper to retain the switch members in contact while the lateral movement of the actuator is completed by the spring memb



No. 571,951.—Means for Generating Electricity from Car Wheels.

571,946. ELECTRIC ARC LAMP; C. Eschwei Long Island City, N. Y. App. filed Sept. 11, 1896. In an electric arc lamp, the combination of a solenoid, a tubular magnet in said solenoid, a bracket-plate attached to the lower end of said magnet, a clutch located below the bracket-plate, and formed of a socket and clutch members, a ring-shaped plate resting on the clutch members, and angular pivot arms applied to the bracket-plate and socket, and adapted to exert pressure on said clutch members and cause them to grip the carbon holder as soon as the tubular magnet is drawn into the solenoid.

571,948. TELEGRAPH; L. W. Hilldburgh, New York, N. Y. App. filed. March 5, 1896. In a system of electrical communication with a main line and a source of alternating-current therefor, of two normally-closed loops at each station over which the positive and negative waves of the alternating-current are caused to pass separately, and transmitting and receiving instruments at the stations.

571,950. FIRE ALARM SIGNAL-BOX; G. F. Milliken, Boston, Mass. App. filed Dec. 14, 1891. The combination in a signal apparatus of a time-train, a non-interference magnet in the circuit, a signal-wheel driven by the said train, having its first tooth longer than the others, and adapted to make two or more rotations to repeat the signal, and a contact in the main line operated by the time-train at times when the long tooth of the signal-wheel is under the contact springs on all rotations succeeding the first.

571,951. MEANS FOR GENERATING ELECTRICITY FROM CAR WHEEL AXLES; M. Moskowitz, Newark, N. J. App. filed July 19, 1895. In a means for generating electricity from a car wheel axle, the combination with a car wheel axle, of a dynamo on said axle, a governor arranged on the axle, an electric regulating device controlled by said governor, adapted to equalize the output of electricity of the dynamo and maintain the same constant, and a pole changer comprising therein a pivotally-arranged contact-arm and means for actuating said arm from the car wheel axle, and contacts in circuit with said dynamo.

571,952. ELECTRIC SWITCH; M. Moskowitz, Newark, N. J. App. filed June 11, 1896. An electric switch comprising therein an electromagnet having a pole piece, an electromagnet having an armature and a soft iron shoe secured to said magnet, so that the said armature is movably arranged between the ends of said pole pieces and said shoe.

571,974. ELECTRIC ARC LAMP; G. R. Lean, Cleveland, O. App. filed May 23, 1896. In an arc lamp the combination with a magnet core and armature, of a helix encircling said core and included in series with the carbons of the lamp, a constantly closing conductor also encircling said core, whereby to effect the gradual starting and stopping of the lamp, and a clutch supported by said armature.

571,975. CARBON HOLDER; G. R. Lean, Cleveland, O. App. filed May 23, 1896. A carbon holder comprising a sleeve, an adjustable cap on the end of the sleeve and an annular coiled spring within said cap and adapted to be formed against the carbon.

571,976. ELECTRIC ARC LAMP; G. R. Lean, Cleveland, O. App. filed July 7, 1896. In an arc lamp, the combination with a depending arm, and a yoke at the lower end of said arm, of an outer globe holder removably connected to said yoke, and an inner or arc inclosing globe holder hinged to said arm above the yoke.

571,977. BINDING POST FOR ELECTRIC BELLS, ETC.; F. W. Manger and O. H. Huebel, Brooklyn, N. Y. App. filed March 24, 1896. The combination with a base plate having a hole therein and a recess in its rear face, said recess having straight walls, of a binding post adapted to pass through said hole in the base plate and having a head to enter said recess and conform thereto, a washer adapted to screw on said post whereby to prevent endwise movement thereof, and a clamping nut on said post.

571,974. TROLLEY FINDER; W. J. Donahue and W. B. Hausman, Philadelphia, Pa. App. filed Oct. 10, 1895. A trolley finder, consisting of a wheel having right and left hand grooves increasing in diameter toward the centre and merging with the central groove on diametrically opposite sides of the wheel, and a suitable support.

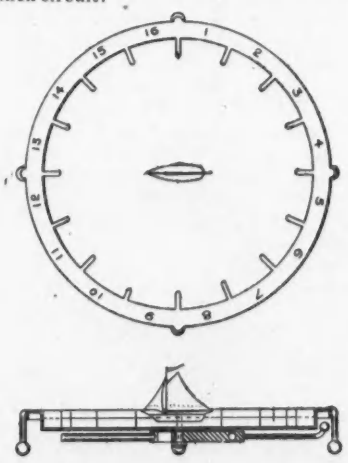
571,997. GAME APPARATUS; A. W. Fall, Hoboken, N. J. App. filed Jan. 7, 1896. A game apparatus, comprising a water receptacle and a float constituted in part of magnetizable material, a single rotating magnet substantially equal in length to the radius of the receptacle, and pivoted to the under side of said receptacle at a point intermediate the bend in the magnet and the polar ends thereof, a number of movable supports for said magnet lying at different points about its axis of rotation, a central bearing for said supports, and radial arms extending from said supports to the edge of the water receptacle.

572,013. UNDERGROUND ELECTRIC POWER SYSTEM FOR RAILWAYS; W. L. King, Winston, N. C. App. filed May 21, 1896. An underground electric power system for railways, comprising a conduit, a main current wire in said conduit, a main source of electricity with which the wire connects, a return circuit carrier having connection with said source of electricity, a sectional main-working conductor in the conduit, an auxiliary-working conductor in the conduit, a motor carried by a car and arranged in a circuit between the main-working conductor and return-circuit carrier, a three-point switch carried by the car, a shunt wire having a resistance connecting one of the switch points with the circuit leading through the motor, an electric generator carried by the car and having one of its poles in connection with one of the switch points and the other of its poles in connection with a track-rail, a connection between one of the switch points and the auxiliary conductor and a circuit closer for closing a circuit between the main current wire and the main-working conductor, the said circuit closer being operated from the generator carried by the car, or from a current derived from the main circuit.

572,036. WHEEL WITH ELECTRICAL MOTOR HUB FOR VEHICLES; C. Theryc, Marseilles, France. App. filed July 31, 1896. In a vehicle wheel with median electric motor, the combination with the axle having bearings in supports on the vehicles, an armature and a commutator on the axle, a box or barrel hub to which the inner ends of the spokes are connected, having roller bearings about the axle and forming an inclosure for the motor mechanism, a field magnet secured to the interior of the hub about the armature, brush holders on the interior of the hub carrying brushes bearing against the commutator, two metal rings on the exterior of the hub connected respectively with the commutator brushes, other brushes on the frame work of the vehicle bearing respectively against the rings connected with a source of electricity on the vehicle, a pinion at one end of the axle, an internal rack on the hub, and an intermediate pinion and rack and rotating on a journal-pin fixed to the vehicle.

572,057. ANNUNCIATOR; F. A. Jennings, Ithaca, N. Y. App. filed May 11, 1895. A dial containing train bulletins, a pointer mounted upon a pointer-shaft and a scape wheel also upon said shaft in combination with an electromagnet, an escapement yoke mounted upon a pivot and provided with pallets adapted to engage with said scape wheel and a rod adjustably connecting said yoke to the armature, whereby said scape wheel is intermittently rotated by the making and breaking of the circuit through said magnet.

572,080. SPEEDING DEVICE FOR RACE TRACKS; H. G. Wilshire, Los Angeles, Cal., and M. C. Massie, Washington, D. C. App. filed May 12, 1896. The combination with a railway, a car movable on the railway, a motor arranged to propel the car, and a main circuit in which said motor is included, of a branch circuit, means for energizing both circuits, an indicator motor in the branch circuit, and indicating mechanism operated by the motor in branch circuit.



No. 571,997.—Game Apparatus.

572,081. AUTOMATIC TEMPERATURE ANNUNCIATOR; J. A. Young, Indianapolis, Ind. App. filed May 11, 1896. An annunciator for announcing limits of maximum and minimum degrees of temperature in a room, comprising in combination a base, a thermometer attached thereto; a sensitive bar mounted at one end to a metal post secured to said base and having its opposite end in proximity to another metallic post secured to said base, said post being provided with adjustable screw nuts which may be moved into proximity to the end of said bar, the said bar being composed of two strips having unequal ratios of expansion secured together; suitable binding posts secured to said base and connected by wires in an electric circuit, so that said bar forms part of the circuit when its free end is in contact with said adjusting-nuts